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ON THE LAWS OF INHERITANCE IN MAN*.

I. INHERITANCE OF PHYSICAL CHARACTERS.

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CONTENTS.

		Page
(i)	Introductory	357
(ii)	Material. Family Record Series	358
(iii)	Theory Applied	361
(iv)	Size and Variability of Characters in two Generations	370
(v)	Direct Assortative Mating in Man	372
(vi)	Cross Assortative Mating in Man	375
(vii)	Direct Parental Inheritance	377
(viii)	Cross Parental Inheritance	383
(ix)	Direct Fraternal Correlation	387
(x)	Cross Fraternal Correlation	392
(xi)	General Conclusions	393
(xii)	Appendix of Correlation Tables	397

(i) *Introductory.*

ABOUT eight years ago I determined to supplement the data obtained by Mr Francis Galton for his work *Natural Inheritance* by a rather wider series of measurements on blood relations in man. Mr Galton had most generously placed his original data at my disposal and I had used them as far as stature was concerned in my memoir of 1895† and in a joint paper with Dr Lee in 1896‡. The eye-colour data of his Family Records were not reduced§ until after the discovery of a method for dealing with characters not capable of exact quantitative measurement‖, and it is only recently that the full scheme of relationships back to great-grandparents has been completed¶. There were about 200 families in Mr Galton's records and only one measurable character, stature. The conditions

* I must gratefully acknowledge aid in the publication of the elaborate tables which accompany this memoir from a grant made to my department in the University of London by the Worshipful Company of Drapers.

† "Regression, Heredity and Panmixia." *Phil. Trans.* Vol. 187, pp. 253—318.

‡ "On Telegony in Man." *R. S. Proc.* Vol. 60, p. 274 *et. seq.*

§ "On the Inheritance of Eye Colour in Man." *Phil. Trans.* Vol. 195, pp. 102—121.

‖ "On the Correlation of Characters not quantitatively Measurable." *Phil. Trans.* Vol. 195, pp. 1—47.

¶ F. E. Lutz: "Note on the Influence of Change in Sex on the Intensity of Heredity." *Biometrika*, Vol. II. pp. 237—240.

as to age of the measured, or to method of measurement were not, perhaps, as stringent as might now be considered desirable, but Mr Galton's data were amply sufficient to lead him to his great discovery of the general form of the inheritance of blending characters in a stable community. The full significance of this discovery is hardly yet understood, and one constantly notices grave misinterpretations of Mr Galton's theory in the works of non-statistically trained biologists. The constants as determined from Mr Galton's stature data did not seem to me to be final; they were to some extent irregular and were not in full accord with the more uniform eye-colour results. It therefore appeared to me desirable to obtain further data, not only for several physical characters and to compare the results for these characters with those for mental characters, but to deal with both in as wide as possible a system of blood relationships. This was provided for in the following series of observations:

I. *Family Record Series.* About 1893 I drew up in conjunction with my then colleague, W. F. R. Weldon, the directions for family measurement which are described below. The measurements were in great part carried out by college students*, and I largely owe the success of this series to the energy and time devoted to the collection of the data by Dr Alice Lee. In the course of four to five years about 1100 cards were filled in. The tabling of the data on these cards and the calculation of the statistical constants, some 78 tables in all, are due entirely to Dr Lee, and occupied her spare time for nearly two years.

II. *School Record Series.* This series was started some years later and was aided by a grant from the Government Grant Committee. Its object was to record the mental and physical characters in pairs of brothers, of sisters, and of sisters and brothers in schools. About six thousand children were observed and measured, and provided more than 3000 pairs of brethren to illustrate in a great variety of ways the intensity of collateral resemblance in man. This series will only be dealt with incidentally in the first part of this paper, about 150 of the tables have been formed and the correlations deduced from them, but much work remains still to be done on the data for schools.

III. *Cousinship Series.* A third series on the ten kinds of first cousins is now being started with aid from the Government Grant Committee to complete our quantitative conceptions of collateral heredity. But it will be a number of years before the data here desired can be fully collected and still longer before the reductions can be completed. The above series form the material from which it is proposed to obtain quantitative measures of the degree of resemblance between blood relations in man. The present memoir deals primarily with the Family Record Series.

(ii) *Nature of the Family Record Series.*

It seems desirable to give the actual form of the instructions and schedule by aid of which the data were collected.

* I must take this opportunity of most heartily thanking the many helpers, who devoted much time and energy to measuring not only single but often 10 or 20 families.

FAMILY MEASUREMENTS.

Professor KARL PEARSON, of University College, London, would esteem it a great favour if any persons in a position to do so, would assist him by making one set (or if possible several sets) of anthropometric measurements on their own family, or on families with whom they are acquainted. The measurements are to be made use of for testing theories of heredity, no names, except that of the recorder, are required, but the Professor trusts to the *bona fides* of each recorder to send only correct results.

Each family should consist of a father, mother, and at least one son or daughter, not necessarily the eldest. The sons or daughters are to be at least 18 years of age, and measurements are to be made on not more than two sons and two daughters of the same family. If more than two sons or two daughters are easily accessible, then not the tallest but the eldest of those accessible should be selected.

To be of real service the whole series ought to contain 1000—2000 families, and therefore the Professor will be only too grateful if anyone will undertake several families for him.

Copies of this paper, together with cards for recording data, may be obtained from

.....

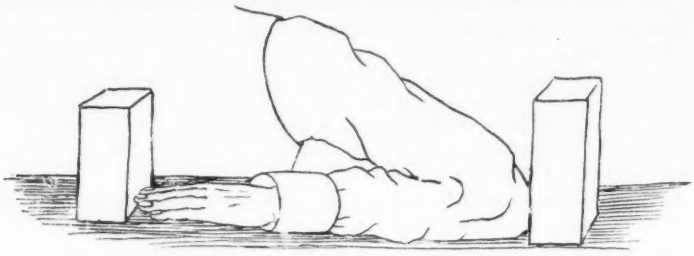
or from the above-named Professor.

The measurements required in the case of each individual are to be to the nearest quarter of an inch, and to consist of the following:—

(I.) *Height.*—This measurement should be taken, if possible, with the person in stockings, if she or he is in boots it should be noted. The height is most easily measured by pressing a book with its pages in a *vertical plane* on the top of the head while the individual stands against a wall.

(II.) *Span of Arms.*—Greatest possible distance between the tip of one middle finger and the tip of the other middle finger, the individual standing upright against a wall with the feet well apart and the arms outstretched,—if possible with one finger against a doorpost or corner of the room.

(III.) *The Length of LEFT Forearm.* The arm being bent *as much as possible* is laid upon a table, with the hand flattened and pressed firmly against the table, a box, book, or other hard object is placed on its edge so as touch the bony projection of the elbow, another so as to touch the tip of the middle finger. Care must be taken that the books are both perpendicular to the edge of the table. The distance between the books is measured with a tape.



Or,

The arm being bent *as much as possible* the elbow is pressed against the corner of a room or the doorpost, the hand being flattened and pressed against the wall. The greatest distance from the tip of the middle finger to the corner or doorpost is to be measured.

Sample of filled in Data Card of Family Measurements.

		Height*		Span of Arms		Left Forearm	
One Family only		Feet	Inches	Feet	Inches	Feet	Inches
Father... ... ... (Not step-father)		5	9¼	6	1½	1	7¼
Mother ... ... (Not step-mother)		5	0¾	5	2	1	4¼
	Age						
Son ...	26	5	7¼	5	11	1	6½
Son ...	—	—	—	—	—	—	—
Daughter	30	5	4¼	5	5	1	4½
Daughter	24	5	5¼	5	6¼	1	5

Name and Address of Recorder (not to be published in any way, but for convenience of reference).

Miss A. L. Robinson,

Blounts Court Mansions, Kensington, S.W.

.....

Both father and mother are absolutely necessary and should not be over 65 years of age.

All the measures are to be recorded to the nearest quarter of an inch. Before measuring read the notice circulated with this card, and kindly return the card as soon as possible to

[Name of individual collector was here inserted]

or to Professor Karl Pearson, University College, London, W.C.

* Put B against numbers if measure is taken in boots. If any person measured has ever broken a leg, arm or collar-bone, put L, A, C against all his or her measurements.

It is not for a moment suggested that the instructions or schedule form are ideal; they are of course open to criticism of a variety of kinds. But they were not settled without considerable thought and a definite reason for each point stated. Thus full growth is not reached at 18 years of age, perhaps not till 25. The growth, however, from 18 to 25 is relatively small, although sensible, and by fixing our limit at 25, we found a very large number of families would be cut off, for both parents would not be surviving, or, if surviving, beyond the age limit fixed for parents. Further, we should have been unable to interest college students effectively in the matter, as the bulk of them fall between 19 and 22. Again, it would have been better to take a lower maximum age for the parents, but in doing so we should again have greatly limited our available material. Better organs might undoubtedly have been selected than stature, span and forearm, e.g. head and finger measurements, but in such cases instruments and greater elaboration are needed, and the difficulty of obtaining upwards of 1000 families, already very great, would have been much intensified. We chose organs easily measured with moderate accuracy and asking for the nearest quarter-inch, only tabulated stature and span to the nearest inch, and forearm to the nearest half-inch. Thus the slight diurnal variations and the errors of measurement of the characters will not sensibly affect the constants calculated from our tables. Only a small percentage were measured in boots; we could not insist that ladies and gentlemen in middle life must remove their boots, or we might have met with a far larger number of refusals to be measured. Still the bulk of the measured did remove boots. After some experimenting on the effect of heels on apparent stature it was found that the subtraction of an inch from the recorded stature fairly represented the average increment due to boots. Hence the small percentage of boot entries was reduced before tabling by one inch.

Of course each family card did not provide us with four children, our maximum number allowed. Thus the number of our parental pairs lies for the different tables between 1000 and 1400, while for the fraternal correlations we have results based on 350 to 1400 pairs, according to the nature of the table. This is due to the fact that it was found far more difficult to get the measurements on *two* adult brothers, than on two sisters*. It was partly this defect in the number of pairs of brothers which led to the wider system of school measurements on brothers. The latter, however, do not modify but only confirm the results obtained from the smaller series in the *Family Records*.

I now propose to deal at length with the results obtained from our material.

(iii) *Theory applied.*

The regression in all cases is essentially linear, i.e. very closely linear within the limits of random sampling. It is impossible to give diagrams of all the 2×78

* Probably two adult brothers were far more rarely found both living at home, or if at home declined to be submitted to a measurement, which offered no immediate advantage to themselves.

regression lines of the 78 correlation tables, but the following three cases are a fair *random* sample of what actually occurs*.

Diagram I. *Stature of Father and Son.*

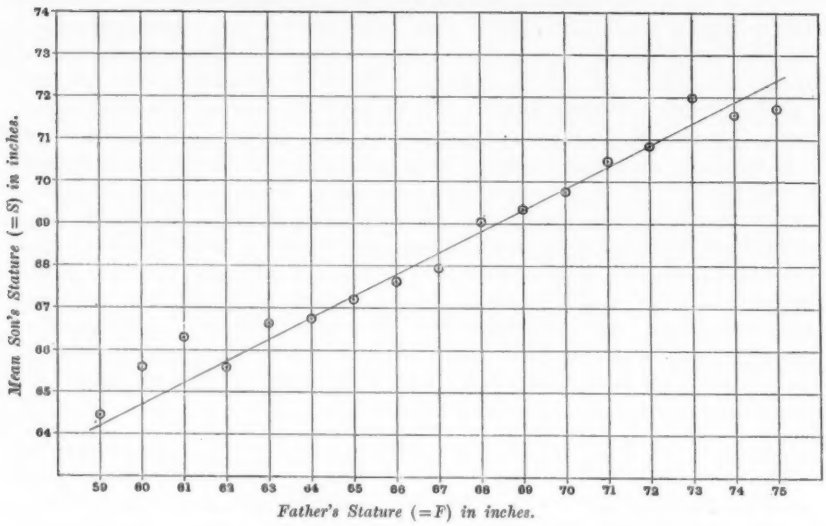
Diagram II. *Span in Mother and Daughter.*

Diagram III. *Brother's Forearm and Sister's Span,*

the latter being an example of a cross-correlation.

DIAGRAM I. *Probable Stature of Son for given Father's Stature.*

Regression Line: $S = 33{\cdot}73 + {\cdot}516\,F$. 1078 Cases.



It will be seen from these cases that, except near the terminals, where the numbers of cases are very few, that the regression is closely linear. We are thus relieved from any difficulties about regression or correlation. We have only to find the ordinary coefficient of correlation r, and the regression coefficient $r\sigma_1/\sigma_2$, and these will suffice to describe the average degree of hereditary resemblance. All this is done without any assumption of the normal curve of frequency. As a matter of fact, however, the normal curve very closely suffices to describe the distribution of many physical characters in a human population. This is illustrated in the accompanying diagrams which are fair samples of stature and span frequencies. In Diagram IV. we have the following data for stature in mothers, plotting frequency observed against theoretical frequency.

* A further case from the data, that of cubit in Father and Son, was given in *Biometrika*, Vol. II. p. 216.

Mean Daughter's Span (=D) in inches.

DIAGRAM II. *Probable Span of Daughter for given Mother's Span.*
Regression Line: $D = 34{\cdot}18 + {\cdot}473\,M$. 1370 Cases.

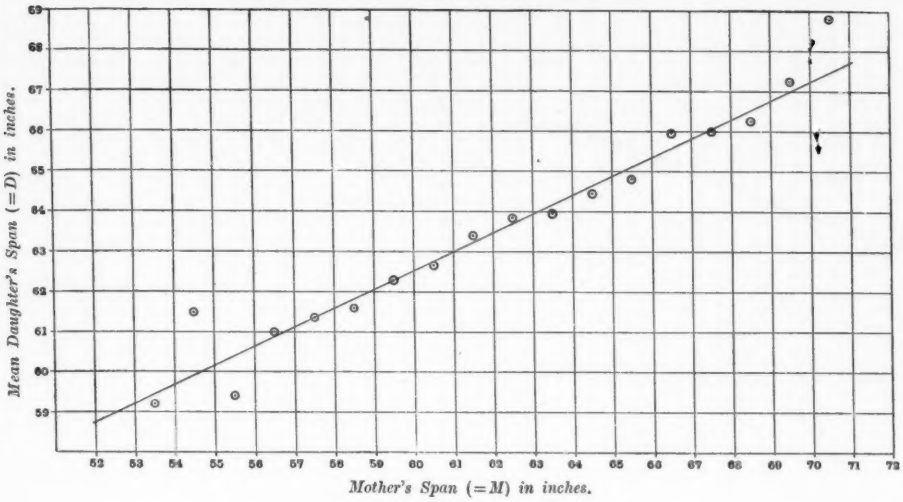


DIAGRAM III. *Probable Span of Sister for given Forearm in Brother.*
Regression Line: $S = 39{\cdot}66 + 1{\cdot}280\,B$. 1399 Cases.

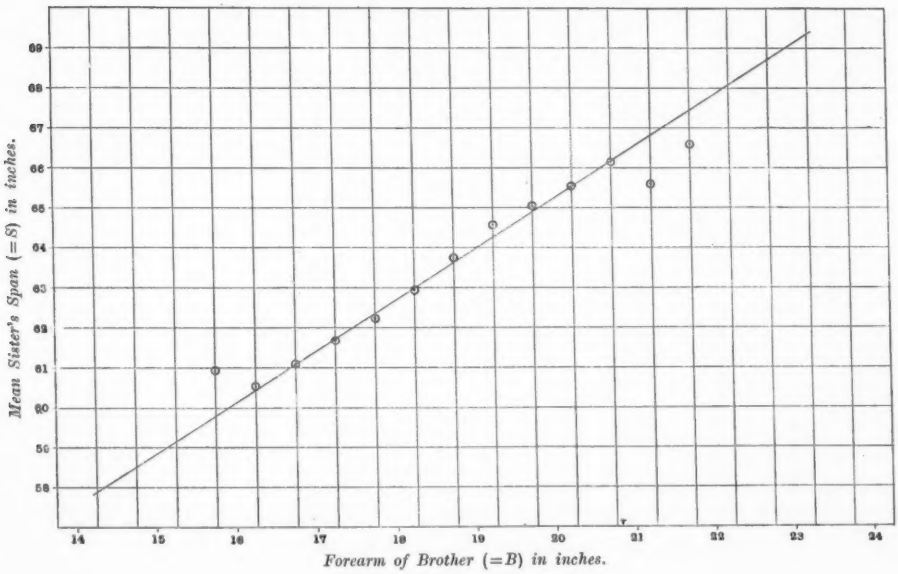
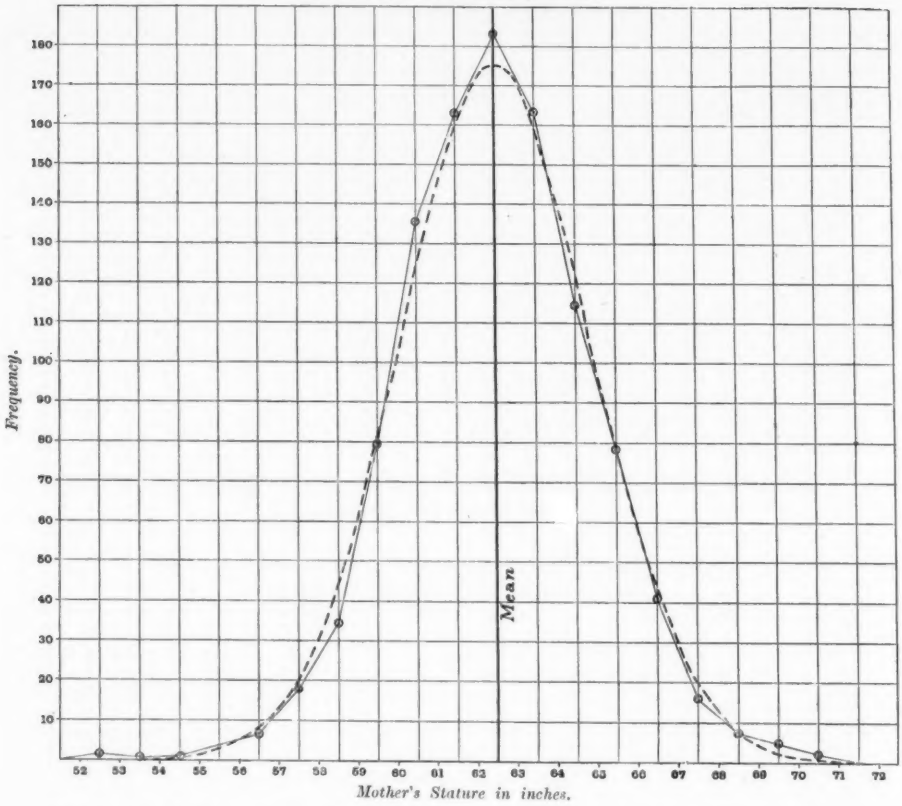


DIAGRAM IV. *Distribution of Stature.*



Stature in Mothers. 1052 *Cases.* *Mean* = 62″·484, *Standard Deviation* = 2″·3904.

Stature in inches	*52—53*	*53—54*	*54—55*	*55—56*	*56—57*	*57—58*	*58—59*	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*
Observed Frequency	1·5	·5	1	2	6·5	18	34·5	79·5	135·5	163	183	163	114·5	78·5	41	16	7·5	4·5	2
Normal Frequency		·9		2·6	7·9	20·9	44·5	80·8	124·1	160·3	174·3	159·4	122·8	79·5	43·2	20·1	7·7	2·5	·8

Sheppard's Tables* were used. If we test goodness of fit by my general method†, using Elderton's Tables and notation‡, we find: $\chi^2 = 14{\cdot}47$, and for

* *Biometrika*, Vol. II. p. 182 *et seq.* † *Phil. Mag.* Vol. I. pp. 157—175.

‡ *Biometrika*, Vol. I. p. 155 *et seq.*

17 groups this gives $P = \cdot 56$, or, if stature in mothers really obeys a normal law, we should expect worse results by way of fit in 56 out of 100 samples of 1052 mothers. Thus the degree of fit may be considered good. There is some irregularity at the left-hand tail, where I have clubbed three groups together. There is generally an improbable outlier or two in most of these distributions, possibly the result of some slip in measurement, or perhaps special deformity or result of disease not recorded on the cards*.

In Diagram V. we have the following data for span in sons:

Span in Sons. 1156 *Cases.* *Mean* = 69″·94, *Standard Deviation* = 3″·0869.

Span in inches	*58—59*	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	*72—73*	*73—74*	*74—75*	*75—76*	*76—77*	*77—78*	*78—79*	*79—80*	*80—81*	*81—82*
Observed Frequency	·5	·5	·5	3·5	4	13	32	64·5	84·5	105	132·5	153·5	152	125·5	102	76·5	47·5	28	11·5	9	7	1·5	·5	1
Normal Frequency	2·2			3·7	8·3	17·2	31·9	53·4	80·5	109·1	133·2	147·3	146·3	131·1	105·9	76·9	50·6	29·8	15·8	7·6	3·2	1·3	·6	

In this case we have for 21 groups, $\chi^2 = 14 \cdot 63$ and $P = \cdot 80$, or in 80 trials out of 100 we should expect the group of 1156 sons to diverge more from the normal distribution than our observed results do. Again we have an excellent fit. It would seem that for stature and span we may fairly use a normal distribution, even as it may be used for cranial and cephalic measurements†. But biometric results are always a field for surprises, partly because of the complexity of causes to be dealt with, partly because we are really only at the beginning of our

* It is even conceivable that a measurer went out of the way to get a very small man or woman, as in a case where one contributor wrote: "I have got with some difficulty the ——'s, a very tall family."

† Macdonell, *Biometrika*, Vol. I. p. 183 *et seq.* and Fawcett, *Ibid.* Vol. I. p. 443.

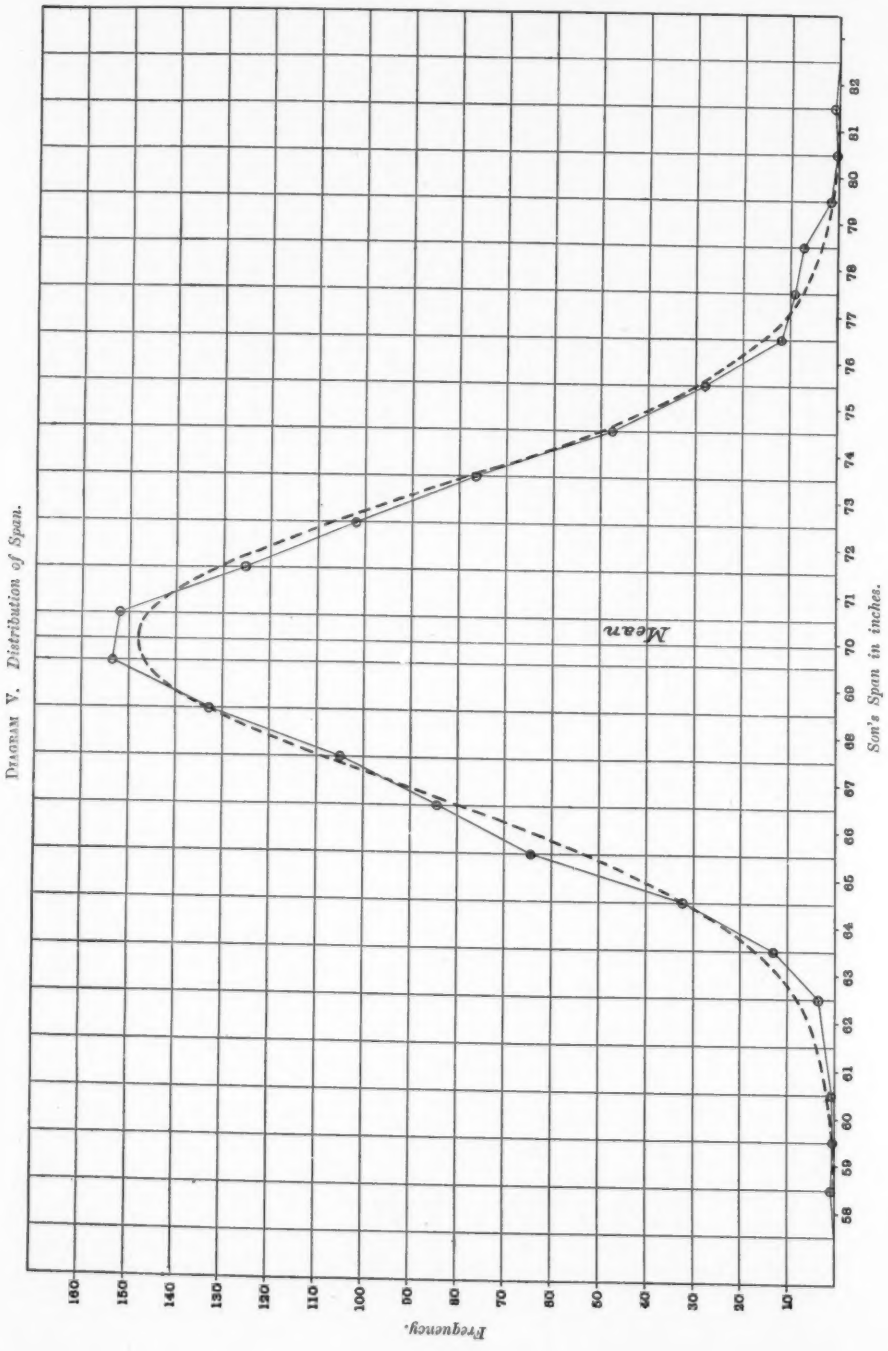


DIAGRAM V. *Distribution of Span.*

collections of data. I may have been unfortunate in my choice of the forearm as more difficult of measurement, or more subject than span to growth influences, but the results for the forearm diverge considerably more from normality than those for stature or span. I give my conclusions for the three cases I have investigated. These are as follows:

Forearm in Fathers: 14 groups, $\chi^2 = 35{\cdot}18$, $P = {\cdot}000$,
„ in Daughters: 14 groups, $\chi^2 = 33{\cdot}51$, $P = {\cdot}003$,
„ in Sons: 15 groups, $\chi^2 = 30{\cdot}76$, $P = {\cdot}007$.

The improbability of the normal distribution is, however, in all these cases chiefly due to a little lump of "outliers" at the "giant" end of the distribution. There are four fathers with excessive forearms, four daughters with the like and four sons also. These twelve cases cannot, I feel sure, be in the bulk due to slips of measurement, they may be due to some anomalous growth or to a reversion to an excessive radius. If we remove them we find roughly: $P = {\cdot}45$ for fathers, $= {\cdot}21$ for sons and $= {\cdot}18$ for daughters, i.e. we obtain an excellent normal curve fit in the first case, and quite fair ones in the other two. We are therefore forced to the conclusion that forearm in the bulk follows fairly closely a normal distribution, but there appears to exist in man a small abnormal group with excessive forearms, of less than ·5 per cent. The following is the table of observed and theoretical results for forearm in fathers:

Forearm in Fathers. 1050 *Cases.* *Mean* = 18″·31, *Standard Deviation* = ″·963.

Forearm in inches	*15—15·5*	*15·5—16*	*16—16·5*	*16·5—17*	*17—17·5*	*17·5—18*	*18—18·5*	*18·5—19*	*19—19·5*	*19·5—20*	*20—20·5*	*20·5—21*	*21—21·5*	*21·5—22*	*22—22·5*
Observed Frequency	1	6·5	17	49	125·5	200	235·5	183·5	127	57·5	31·5	8	3·5	2	2·5
Normal Frequency	1·9	6·7	23·0	59·6	119·0	182·2	214·8	194·3	135·0	72·0	29·5	9·3	2·2	·5	

This is shown in Diagram VI. The mere graphical inspection of such a result as this would hardly lead us to give proper weight to the abnormal group of outliers, which carry P from ·45 to ·000. To some it might seem a good fit, but the trained eye sees at once defects and $P = {\cdot}000$ shows how great they are*.

* It is almost in vain that one enters a protest against the mere graphical representation of goodness of fit, now that we have an exact measure of it. As typical cases in which quite recently arguments are based on mere graphical appreciation, I would refer to an article by Thorndyke on "Fertility in Man" (*Popular Science Monthly*, Vol. 63, pp. 64 and 84) wherein the skewness of fertility distributions is denied on graphical appreciation of curves, which are analytically skew by odds of the order of a 1000 to 1! Another transgressor is Johannsen, who in his recent work *Ueber Erblichkeit in Populationen und in reinen Linien*, asserts on mere graphical appreciation that certain data are normal and other non-normal and bases arguments on these assertions, whereas the eye alone cannot possibly judge whether or no his distributions follow the normal law. If biologists use biometric methods, they must be reminded that no vague appreciation will answer biometric problems, they must study sufficient mathematics to apply the necessary tests and criteria on which alone biometric arguments can be safely based.

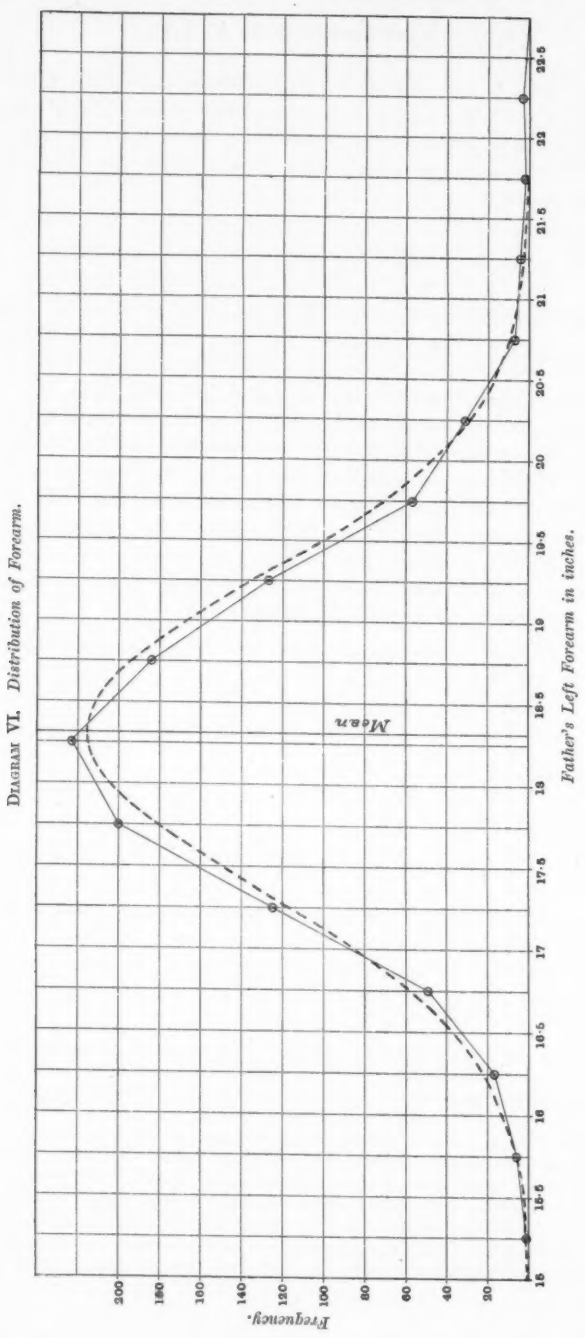


DIAGRAM VI. *Distribution of Forearm.*

The following is the Table for forearm in sons.

Forearm in Sons. 1156 *Cases.* *Mean* = 18″·52, *Standard Deviation* = ″·983.

Forearm in inches	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	22·5—23	23—23·5
Observed Frequency	1	1	1	5·5	10	39·5	95	177·5	260·5	225	166·5	105	41	14·5	7·5	4·5	—	—	1
Normal Frequency	·2		1·0	4·7	17·1	47·5	102·7	171·7	223·8	225·7	177·3	107·7	51·0	18·7	5·3	1·2	·2		

This Table as well as the previous one suggests that a small but sensible element of skewness in the forearm as well as the outlying group contributes to the divergence from normality.

It will be seen that our present data justifies Mr Galton's original use for stature of the normal curve and the normal surface, i.e.

$$z = \frac{N}{2\pi\sigma_x\sigma_y\sqrt{1-r^2}}\, e^{-\frac{1}{2}\frac{1}{1-r^2}\left\{\frac{x^2}{\sigma_x^2}-\frac{2xyr}{\sigma_x\sigma_y}+\frac{y^2}{\sigma_y^2}\right\}}$$

(where $z\,\delta x\,\delta y$ is the frequency of a group of relative pairs having characters with deviations from their means lying between x, y and $x+\delta x$, $y+\delta y$; N being the total number of pairs, σ_x, σ_y being the standard deviations, and r the coefficient of correlation of the two characters: see *Phil. Trans.* Vol. 187, A, p. 264 *et seq.*). It also is fully justified for span and even for forearm (if we remember that there exists a small group of "outliers"). The normality of the distribution adds little, however, to our investigation, as long as we can show that the regression is practically linear (see Diagram III.). The practical value of normality arises chiefly when we pass from measurable characters in man to those that are not capable of exact quantitative measurement, for here every exception to normality weakens our general position.

The general linearity of our regression lines enables us in the present case to apply a simple theory, as soon as we have calculated the means, the standard deviations, and the correlations of the various characters.

These will enable us, by using the formulae of simple or multiple correlation, which depend simply on linearity, to predict the probable character in any individual from a knowledge of one or more parents or brethren ("siblings," = brothers or sisters). But without further assumption they do not enable us to test the effect of long-continued selection in establishing stocks; for we have no ancestral correlations, beyond the parental, for the characters dealt with. Ancestral correlations beyond the parental are, however, known for man in eye-colour inheritance (up to great-grandparents), for horses in coat-colour (up to great-great grandparents), and for dogs in coat-colour (up to grandparents). Hence, if the parental correlations for men, horses and dogs are sensibly the same,

we shall have small hesitation in assuming that the ancestral correlations for stature, span and forearm in man are closely alike in value to those for his eye-colour and for other characters in horse or dog. We shall thus be able to extend our theory, so as to deduce from our data the rate at which selection, natural or artificial, would establish stocks in man, and further, the limitations there are to the conception of an indefinitely active regression following on the suspension of selection.

It will be found that as far as the actual values are concerned our *Family Records* give values for heredity in man very sensibly larger than Mr Galton's stature data, and much closer to those obtained from his eye-colour data and for coat-colour in horses and dogs.

(iv) *Size and Variability of Characters in the two Generations.*

I will first consider whether there is a sensible change in type between the older and younger generation of our own epoch. The problem is not so easy to answer as it might *à priori* appear to some. We have the following results:

TABLE I. *Alteration in Type.*

Means		Stature	Span*	Forearm
1st Generation	Father ...	67″·68 ± ·06	68″·67 ± ·07	18″·31 ± ·02
	Mother ...	62″·48 ± ·05	61″·80 ± ·06	16″·51 ± ·02
2nd Generation	Son	68″·65 ± ·05	69″·94 ± ·06	18″·52 ± ·02
	Daughter...	63″·87 ± ·05	63″·40 ± ·05	16″·75 ± ·02
Standard Deviations		**Stature**	**Span**	**Forearm**
1st Generation	Father ...	2″·70 ± ·04	3″·14 ± ·05	0″·96 ± ·01
	Mother ...	2″·39 ± ·04	2″·81 ± ·04	0″·86 ± ·01
2nd Generation	Son	2″·71 ± ·04	3″·11 ± ·04	0″·98 ± ·01
	Daughter...	2″·61 ± ·03	2″·94 ± ·04	0″·91 ± ·01
Coefficients of Variation		**Stature**	**Span**	**Forearm**
1st Generation	Father ...	3″·99 ± ·06	4″·64 ± ·07	5″·24 ± ·08
	Mother ...	3″·83 ± ·06	4″·62 ± ·07	5″·21 ± ·08
2nd Generation	Son	3″·95 ± ·06	4″·51 ± ·06	5″·29 ± ·07
	Daughter...	4″·09 ± ·05	4″·71 ± ·06	5″·43 ± ·07
Organic Correlations		**Stature and Span**	**Span and Forearm**	**Forearm and Stature**
1st Generation	Father ...	·783 ± ·008	·752 ± ·009	·640 ± ·012
	Mother ...	·756 ± ·009	·677 ± ·011	·597 ± ·013
2nd Generation	Son	·802 ± ·007	·758 ± ·008	·686 ± ·011
	Daughter...	·828 ± ·006	·771 ± ·007	·716 ± ·009

* We note here a secondary sexual difference, the span on the average is about 1″ greater than the stature in man, and about ·5″ less than the stature in woman.

Now this Table contains a number of most interesting points.

In the first place the probable errors show us that for all three characters in both sexes the younger generation is distinctly larger than the older generation, son than father, daughter than mother. Is this a real progress in type? Taking Mr Powys' diagram for shrinkage in stature*, we should expect our men to reach a maximum at about 28 and our women at 25. Hence, since the average age of our younger generation is not more than 22 years, the younger generation cannot have reached its maximum. On the other hand, our average age of parents must be about 50. Let us suppose them to be 55 even. The difference in age of parents and offspring would thus mark a shrinkage of about ·5″ at a maximum. But the difference between fathers and sons is about an inch for stature and span, and for mothers and daughters about an inch and a half. It seems impossible therefore to attribute the whole change between the two generations to old-age shrinkage. In the next place, can it be due to periodic selection, i.e. only a portion of the younger generation become fathers and mothers? If so, we should expect not only a change in type, but a change in variability between the two generations. Comparing the standard deviations of fathers and sons, we see that fathers and sons are within the limits of random sampling equally variable. On the other hand daughters' standard deviations are in every case sensibly larger than those of their mothers. It would thus seem highly probable that the causes at work in the cases of the two sexes are not entirely the same. Mothers of adult children are a more stringently selected portion of the population than fathers appear to be. Of course some change in type between mothers and adult daughters is undoubtedly due to the fact of child-bearing, independent of any selection in childbed. But it is difficult to see how a physiological effect of this kind could change variability as well as type. I have shown that there is a slight correlation between size and fertility in women†, and this may be partially the source of the observed effect. Whether, however, the result be due to natural or reproductive selection, the change in the variability of the two generations of women seems to me to indicate that there is a selective change going on in the women of the middle classes in this country. The difference in type between fathers and sons,—since there is no change of variability,—might be more likely to be due to improved physical exercise. Of course a portion of the change in the women must also be attributed to this, but the change in variability forbids, I think, its being entirely attributed to this source.

However we judge the matter, whether we consider it due to selection, or to better environment, nourishment, or exercise, there seems no reason to suppose that the population, as far as the middle classes are concerned, is degenerating. In span, stature and forearm the younger generation is sensibly better than its parents.

* *Biometrika*, Vol. I. p. 47.

† *R. S. Proc.* Vol. 59, p. 303. See also Vol. 66, p. 28 *et seq.*

If we compare the two sexes, we see that except in the matter of stature the married woman is *relatively* as variable as the married man, while in all three characters the young woman is relatively more variable than the young man. The supposed preponderance of male variability is thus again very fully negatived, for large statistics of typical physical characters in mankind*.

Turning to the correlations we see (*a*) that in the older generation the mother is less highly correlated than the father, (*b*) that in the younger generation the son is less highly correlated than the daughter, (*c*) that the younger generation of both sexes is more highly correlated than the older generation. Now the effect of selection is to reduce correlation, hence if selection—a selective death-rate—be a real factor in the case of man and we know it to be so, we should certainly expect the correlations between the ages of youth and of middle life to be reduced. They are thus reduced, but far more markedly so in the case of woman than in that of man. Now as far as our data at present reach we know that the male baby is more variable and more highly correlated than the female†. In youth the woman is more variable and more highly correlated than the man; in adult age after child-bearing she is less highly correlated and perhaps very slightly less variable. It would thus seem that between birth and manhood the male is selected and falls in both variability and correlation below his sister. With womanhood comes her period of selection, sexual selection for wifehood, natural and reproductive selection for motherhood. These act with a little expected intensity and leave mothers of adult families with far less variability and correlation than their husbands have.

Of course these changes in variability and correlation may be partly growth changes, but since on the average the man reaches his maximum size four or five years later than the woman and at least four or five years beyond the average age of our group sons, it is difficult to account for the wide difference in variation and correlation between daughters and mothers as compared with that between sons and fathers by growth changes only.

I am inclined to think Table I. is very illustrative of the nature of selection among mankind, and further that it is also hopeful, not as regards the quantity, of which it takes no account, but as regards the quality of the offspring of a fair sample of the English middle classes.

(v) *Direct Assortative Mating in Man.*

We have seen above that all women, if they indeed become wives, do not become the mothers of adult children, i.e. the mothers of the second generation are not a random sample of their own generation. However it may arise there is

* See *The Chances of Death*, Vol. I. pp. 256—377. A recent criticism by Mr Havelock Ellis of my view that there is no preponderating variability of man over woman seems to need no reply, for the author does not appear to understand what weight is to be given to scientific evidence as compared with vague generalities.

† *R. S. Proc.* Vol. 66, p. 25.

certainly a "preferential mating"* taking place. I think we may safely assert that the first factor of sexual selection is active in man. I now turn to the second factor, "assortative mating." If certain women are rejected, at any rate as mothers of adult children, do the remainder mate at random as far as the above three characters are concerned? The answer is most decidedly in the negative, there is a very sensible resemblance in size between husband and wife, which *à priori* I should have said was hardly conceivable. Table II. gives the direct and cross coefficients for assortative mating in man.

TABLE II.

Assortative Mating. Based on 1000 *to* 1050 *Cases of Husband and Wife.*

	Husband's Character	Wife's Character	Correlation and Probable Error	Symbol
Direct	Stature	Stature	·2804 ± ·0189	r_{12}
	Span	Span	·1989 ± ·0204	r_{34}
	Forearm	Forearm	·1977 ± ·0205	r_{56}
Cross	Stature	Span	·1820 ± ·0201	r_{14}
	Stature	Forearm	·1403 ± ·0204	r_{16}
	Span	Stature	·2023 ± ·0199	r_{32}
	Span	Forearm	·1533 ± ·0203	r_{36}
	Forearm	Stature	·1784 ± ·0201	r_{52}
	Forearm	Span	·1545 ± ·0203	r_{54}

We see at once that between the same physical characters in the husband and wife of adult children there is a correlation of upwards of ·2, a most remarkable degree of resemblance, greater than that of great-grandparents to their great-grandchildren (about ·19†), and probably greater than that of first cousins to each other. We could hardly want stronger evidence of the existence of assortative mating in man, i.e. of the actuality of sexual selection. I had previously found‡ from Mr Galton's *Family Records*, that the correlation in stature between *husband and wife* was ·09 ± ·05, but between *father and mother* of adult offspring was ·18 ± ·02. Considering the comparative smallness of material, the latter result is in very good agreement with the present, but it seems to indicate that a portion of the observed resemblance in the parents of adult offspring is due to reproductive selection, i.e. homogamy being a factor of fertility. If the parents of adult children are on the average more alike than first cousins, then it follows that any evils which may flow from first cousin marriage depend not on likeness of characters, but on sameness of stock§.

That the whole result, further, is not due to a mere general custom of men and women mating with persons not differing widely from them in *stature*, is

* *Phil. Trans.* Vol. 187, p. 253 *et seq.* See especially p. 258.

† *Biometrika*, Vol. II. p. 221. ‡ *R. S. Proc.* Vol. 66, p. 30.

§ I have discussed this point more at length, *R. S. Proc.* Vol. 66, p. 29.

shown by the sensible correlation there is in eye-colour between husband and wife, i.e. ·10 ± ·04*, which is closely in agreement with the results for stature of husband and wife from the same data.

We may, however, estimate how far mating with regard to stature would produce resemblances in span and forearm. Let the subscripts 1, 3, 5 refer to three organs in a male of the population who marries, and 2, 4, 6 to the corresponding organs of a female of the marrying part of the population. Then r_{13}, r_{35}, r_{51}, r_{24}, r_{46}, r_{62} are organic correlations such as we have tabled on p. 370. All correlations such as r_{12}, r_{14}, r_{16}, r_{32}, r_{34}, r_{36}, r_{52}, r_{54}, r_{56} are zero, if we mated pairs at random. Now let them be assortatively mated and let ρ_{12}, ρ_{34}, ρ_{56} represent the degree of resemblance in the sexual selection. Let $\mathbf{r}_{12}$, $\mathbf{r}_{34}$, $\mathbf{r}_{56}$ be the apparent correlations of mated pairs; then $\mathbf{r}_{12}$ will not be equal to ρ_{12}, for it is partly due to the degree of assortative mating indicated in ρ_{34} and ρ_{56}, because 3 and 5 are organically correlated with 1, and 4 and 6 with 2; thus the selection of 3's and 5's to associate with 4's and 6's would indirectly influence the relationship of 1 and 2, even if there were no direct associating of 1's and 2's. The relationship of $\mathbf{r}_{12}$, $\mathbf{r}_{34}$, $\mathbf{r}_{56}$ to ρ_{12}, ρ_{34}, ρ_{56} may be easily found from my memoir on the influence of selection on variability and correlation†. We have only to put in the formulae of pp. 15—17 the appropriate values for the population described above and we find:

$$\left.\begin{aligned} \mathbf{r}_{12} &= \rho_{12} \qquad + \rho_{34}\, r_{13}\, r_{24} + \rho_{56}\, r_{15}\, r_{26} \\ \mathbf{r}_{34} &= \rho_{12}\, r_{13}\, r_{24} + \rho_{34} \qquad + \rho_{56}\, r_{35}\, r_{46} \\ \mathbf{r}_{56} &= \rho_{12}\, r_{13}\, r_{26} + \rho_{34}\, r_{35}\, r_{46} + \rho_{56} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}.$$

Now suppose that 1 and 2 represent statures, 3 and 4 spans, and 5 and 6 forearms. Then if all assortative mating be due to selection of stature, we might put ρ_{34} and ρ_{56} zero above and we should have:

$$\rho_{12} = \mathbf{r}_{12}, \quad \mathbf{r}_{34} = \mathbf{r}_{12} r_{13} r_{24}, \quad \mathbf{r}_{56} = \mathbf{r}_{12} r_{15} r_{26}.$$

But $r_{13} = \cdot 7829$, $r_{24} = \cdot 7560$, $r_{15} = \cdot 6397$, $r_{26} = \cdot 5968$, and $r_{12} = \cdot 2804$. This leads to

$$\mathbf{r}_{34} = \cdot 1660 \text{ and } \mathbf{r}_{56} = \cdot 1071,$$

as against the observed values:

$$\mathbf{r}_{34} = \cdot 1989 \text{ and } \mathbf{r}_{56} = \cdot 1977.$$

The former values are too small in both cases and, I think, we may safely assert, that the likeness of husband and wife in forearm and span is not *solely* due to a selection of stature.

Another explanation of these high coefficients of assortative mating has been suggested to me, namely that the population of England is built up of a number

* *Phil. Trans.* Vol. 195, A, p. 113. See also pp. 148—150, where it is shown that heterogamy rather than homogamy in eye-colour tends to increased fertility. If this be confirmed, eye-colour differs much in effect from stature.

† *Phil. Trans.* Vol. 200, p. 1 *et seq.*

of local races, and that men and women mate within their locality. Now it appears to me that this argument would be far more valid, if my material was drawn in bulk from local lower middle and artizan classes. But it is very doubtful how far it is true of the middle classes, such as provide the students at the London colleges. The middle classes undoubtedly marry in their own "sets," but these are hardly local sets. Further, a wide series of assortative mating observations have been made on another, wholly different class of characters, in which local race is regarded, and the coefficients come out as high as in the present data. Hence, I think, we are forced to the conclusion that the bulk of the observed resemblance in physical characters between parents is due to a direct, if quite unconscious, selection of like by like, and possibly in a contributory degree to a likeness in parents for the characters under consideration emphasising their fertility.

The amount of "consciousness" in the selection may possibly be measured by the difference between the stature-stature correlation and those for span-span, and forearm-forearm.

(vi) *Cross-Assortative Mating in Man.*

The second part of Table II. gives the cross-coefficients, for example, the correlation between husband's stature and wife's forearm. We might *à priori*, perhaps, anticipate that the correlation between a first organ in the husband and a second in the wife, would be equal to the correlation between the second in the husband and the first in the wife. This is actually the case for span and forearm, and, perhaps, we may consider for stature and span; the results for stature and forearm are less close than we might have anticipated, but the work has been revised without the discovery of any error. Relations such as:

$$\mathbf{r}_{14} = \mathbf{r}_{32}, \quad \mathbf{r}_{16} = \mathbf{r}_{52},$$

do not, however, appear to be theoretically necessary.

The problem now arises: are cross correlations between characters in husband and wife, solely due to selection of direct characters?

I think this may be roughly tested in the following manner. Suppose *only* these organs to be selected and the direct selection coefficients to be ρ_{12}, ρ_{34}, ρ_{56}, as before. They may be found from equations (i)* and we have the values:

$$\rho_{12} = \cdot 2374, \quad \rho_{34} = \cdot 0053, \quad \rho_{56} = \cdot 1043.$$

Thus there is most immediate selection of stature, a sensible selection of forearm, and practically none of span.

* These give numerically:

$$\cdot 2804 = \rho_{12} + \cdot 5919\rho_{34} + \cdot 3818\rho_{56},$$
$$\cdot 1989 = \cdot 5919\rho_{12} + \rho_{34} + \cdot 5087\rho_{56},$$
$$\cdot 1977 = \cdot 3818\rho_{12} + \cdot 5087\rho_{34} + \rho_{56}.$$

Now, if there be no *immediate* cross selection of other than these three organs and no immediate direct selection we should expect to find:

$$\left.\begin{aligned}
\mathbf{r}_{32} &= \rho_{12}r_{13} + \rho_{34}r_{24} + \rho_{56}r_{35}r_{26} \\
\mathbf{r}_{14} &= \rho_{12}r_{24} + \rho_{34}r_{13} + \rho_{56}r_{15}r_{46} \\
\mathbf{r}_{52} &= \rho_{12}r_{15} + \rho_{34}r_{35}r_{24} + \rho_{56}r_{26} \\
\mathbf{r}_{16} &= \rho_{12}r_{26} + \rho_{34}r_{31}r_{46} + \rho_{56}r_{15} \\
\mathbf{r}_{36} &= \rho_{12}r_{13}r_{26} + \rho_{34}r_{46} + \rho_{56}r_{35} \\
\mathbf{r}_{54} &= \rho_{12}r_{15}r_{24} + \rho_{34}r_{35} + \rho_{56}r_{46}
\end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(ii).}$$

Substituting the ρ's and the organic correlations in (ii) we find:

TABLE III.

Coefficients of Cross Assortative Mating.

Husband's Character	Wife's Character	Observed Value	Calculated Value
Span	Stature	·2023	·2327
Stature	Span	·1820	·2288
Forearm	Stature	·1784	·2171
Stature	Forearm	·1403	·2152
Span	Forearm	·1533	·1929
Forearm	Span	·1545	·1894

We conclude from this Table that: since the calculated values are all larger than the observed, the hypothesis that only direct selection of these three characters takes place is not valid. There must be direct selection of other correlated organs, or in some manner, as yet inexplicable, also an immediate cross assortative mating in man*. Generally, the results given in the present and the previous section for assortative mating, and in section (iv) for preferential mating, indicate that in future a greater degree of attention must be paid to sexual selection. It can hardly be so significant in the case of man, where most people would probably *à priori* suppose it of no account, and yet fail to play an important part in wild life. In particular, experimental enquiry on the relation of homogamy to fertility,—the likeness not being due to in-breeding—would be of very great value. It is clear, that "negative"† natural selection accompanied

* My own view, for which I have small evidence at present, is that the functions of sex are far more highly correlated with the physical characters in man than is generally supposed, and that the fertility of any given pair is very delicately atuned to the relative proportions of their frames. Hence when we come to correlate the physical characters in the parents of adult children, we find not only high direct but also high cross correlations, which seem inexplicable on any hypothesis of conscious assorting at mating. The only way to test this is to compare the correlations of husbands and wives at marriage with those of parents of adult children. We have already seen that these in certain cases sensibly differ. (See p. 373 and p. 374 footnote.)

† A selection for destruction not survival: see *Phil. Trans.* Vol. 200, A, p. 59.

by the correlation of homogamy and fertility would much aid us in comprehending the origin of species.

Although we are unable at present to account for the high coefficients of cross-assortative mating in man, it is possible to give an empirical formula, which will enable us to determine these coefficients in terms of the direct assortative mating coefficients and the organic correlations well within the limits of the probable errors of our results. Clearly the cross-assortative mating coefficients ought to vanish with both direct and organic correlations. Hence, if p, q refer to two organs in the husband and p', q' to the same pair in the wife, we should expect the cross correlation $r_{pq'}$ to be of the form:

$$r_{pq'} = Cr_{pp'}r_{p'q'} + C'r_{qq'}r_{pq}.$$

Having satisfied myself that C and C' might be taken as practically equal, I found C as the mean of the last six entries in Table II. There resulted the formulae

$$\left.\begin{aligned} r_{pq'} &= \cdot 5342\ (r_{pp'}r_{p'q'} + r_{qq'}r_{pq}), \\ r_{p'q} &= \cdot 5342\ (r_{pp'}r_{pq} + r_{qq'}r_{p'q'}), \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(iii)}$$

whence I found the following results.

TABLE III *bis.*

Calculated and Observed Cross Coefficients in Husband and Wife.

Husband's Character	Wife's Character	Observed Value	Calculated Value	Difference
Span	Stature	·202	·198	+ ·004
Stature	Span	·182	·196	− ·014
Forearm	Stature	·178	·159	+ ·019
Stature	Forearm	·140	·157	− ·017
Span	Forearm	·153	·151	+ ·002
Forearm	Span	·155	·151	+ ·004

The differences are well within the probable errors, and the above formulae may I think be safely used, if the cross coefficients are unknown.

(vii) *Direct Parental Inheritance.*

For the resemblance in like organs between offspring and parents we have for our three organs twelve cases. The correlations deduced from Appendix Tables XXII.—XXXIII. are given in Table IV. below.

It is impossible to regard these results without extreme satisfaction, not only as confirmation of the general reliability of the material, but also for the weighty evidence they bring for the nature of inheritance in man. When one remembers the labour of collecting the measurements, the days spent in tabling and reducing it, and the doubts which not unnaturally arose as to its value and the value of the tedious labour spent on it, the sense of satisfaction felt may be considered pardonable. The surprising agreement of the results—well within the probable

errors—for each character is to be noted in the first place. Considering that the measurements are made on more than 4000 individuals of different sexes in more than 1000 families, the conviction is complete that these numbers correspond to a

TABLE IV.

Coefficients of Heredity. Parents and Offspring.

Character	Father and		Mother and	
	Son	Daughter	Son	Daughter
Stature	·514 ± ·015	·510 ± ·013	·494 ± ·016	·507 ± ·014
Span	·454 ± ·016	·454 ± ·014	·457 ± ·016	·452 ± ·015
Forearm	·421 ± ·017	·422 ± ·015	·406 ± ·017	·421 ± ·015

reality in nature. From them we may safely draw the following conclusions for the organs examined:

(*a*) The son and daughter are equally influenced by their father, and equally influenced by their mother.

While a change of sex does appear to weaken hereditary influence in the eye-colour of man*, it does not appear to have any perceptible influence on the size of the human frame.

(*b*) In their influence on offspring there is no average prepotency of either father or mother, whatever there may be in individual cases.

(*c*) The inheritance of all characters does not appear to be the same.

The inheritance of forearm is for all four cases sensibly less than the inheritance of span, and that of span less than that of stature. We might as a probability put forward the following statement for further investigation.

(*d*) The more complex a character the greater the intensity of hereditary resemblance.

The fact that the correlation falls below ·5 with the simplicity of the character under consideration seems to suggest, however, that the reduction of the intensity cannot be due to an "alternative inheritance" in the case of the simple components of the character†.

For the mean values we have the following results:

Mean parental inheritance, father to son: ·463
" " " " to daughter: ·462
" " " mother to son: ·452
" " " " to daughter: ·460
Mean parental inheritance for both sexes and all characters: 460.

* *Biometrika*, Vol. II. pp. 237—240.

† See *R. S. Proc.* Vol. 66, p. 142, and *Natural Inheritance*, p. 139.

I think we may fairly take the intensity of inheritance for measurable characters in man to be ·46, or even for rougher work ·5. It may be as well to put on record here the principal results for heredity in the direct line so far reached. I omit the results obtained in my memoir of 1895*, for I consider my present data to replace that series.

TABLE V.

Parental Inheritance in Different Species.

Species	Character	Mean Value	No. of Pairs used	Source	Remarks
Man	Stature	·506	4886	Present Memoir	—
„	Span	·459	4873	ditto	—
„	Forearm	·418	4866	ditto	—
„	Eye Colour	·495	4000	*Phil. Trans.* Vol. 195, p. 106	—
Horse	Coat Colour	·522	4350	*Phil. Trans.* Vol. 195, p. 93	—
Basset Hound ...	Coat Colour	·524	823	*R. S. Proc.* Vol. 66, p. 154	Dams only used
Greyhound ...	Coat Colour	·507	9279	Unpublished data for two characters	Dams and Sires both used
Aphis (*Hyalopterus Trirhodus*) ...	Right Antenna / Frontal Breadth	·439	368	*Biometrika*, Vol. I. p. 129	Ratios only taken to free from growth factor
Daphnia *Magna* ...	Protopodite / Body Length	·466	96	*R. S. Proc.* Vol. 65, p. 154.	

I consider that this table contains the most reliable data we yet have collected and reduced for parental influence on offspring.

The general mean of the whole of these series is ·48 and so far as we have yet gone, we may I think conclude, that:

(*a*) There is no reason for supposing parental heredity to be stronger in one species than a second.

(*b*) Its values lie between ·42 and ·52 and cluster round ·48.

Thus for most practical purposes we may assume parental heredity for all species and all characters to be approximately represented by a correlation of ·5.

In the course of the past 8 years many cases of parental inheritance have been worked out by the biometricians associated with me at University College, some of the most important of these are still unpublished, others have been replaced by far more reliable data; in further cases we know that the material was doubtful, e.g. the cephalic index for *fathers* and children of the North American Indians, or *sire* and offspring in the Basset Hounds. In such cases better material has been sought and our first results modified†. But in the present controversial phase of

* *Phil. Trans.* Vol. 187, p. 253 *et seq.*

† For example the greyhounds have shown that anomalies of the Basset Hound results were peculiar to the material, the cephalic index is inherited quite normally when we test it on material with reliable parentage, etc. etc.

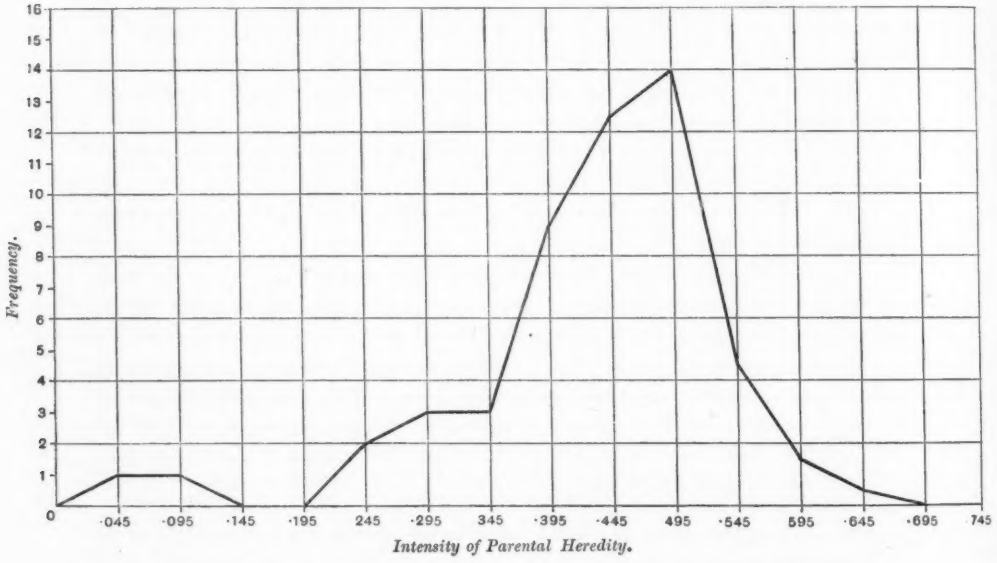
the theory of heredity, it seems well to hold no material back simply because one knows it to be untrustworthy. I therefore give the frequency distribution for every coefficient of parental correlation I am aware of, neither weighting them with the number of pairs on which they are based, nor remarking on the relative reliability of the data, which covers plants, insects and animals.

Frequency Distribution of Correlation Coefficients of Parental Heredity.

Magnitude of Correlation	·02—·07	·07—·12	·12—·17	·17—·22	·22—·27	·27—·32	·32—·37	·37—·42	·42—·47	·47—·52	·52—·57	·57—·62	·62—·67	Total
Frequency	1	1	—	—	2	3	3	9	12·5	14	4·5	1·5	·5	52

This distribution is represented graphically in the accompanying diagram; the mean and standard deviation of the system are ·430 ± ·010 and ·107 respectively. The fact of the cluster and its quantitative intensity are thus rendered obvious. The four extreme observations on the left are due to the Basset Hound Sires and North American Indian Fathers, both involving doubtful paternity*. If we omit

DIAGRAM VII. *Distribution of Correlation Coefficients in 52 Cases of Parental Heredity.*



* Both series are also very small, 100 to 400, as compared with the 1000 or more of most of the other series. As to their questionable character see *R. S. Proc.* Vol. 62, p. 414, and Vol. 66, p. 158 and especially footnote p. 159.

these as most certainly questionable the mean result is ·453 ± ·007, the standard deviation being ·071. Thus ·45 may, I think, be justifiably taken in future to represent the approximate value of parental heredity, in cases where no direct observations have been made for the character and species under consideration. I prefer, however, the ·46 to ·5 of the *best* of the above series.

I now pass to the prediction formulae, i.e. the regression lines and planes, from which the probable value of a character in the offspring may be determined when the value of the character in the parentage is known.

If the subscript c denote child and p parent; and m be the mean, C the character; we have for prediction from one parent:

$$C_c = m_c + \frac{r_{cp}\sigma_c}{\sigma_p}(C_p - m_p) \quad \text{.....(iv)}$$

with a standard deviation for the array of value $\Sigma_c = \sigma_c\sqrt{1-r^2_{cp}}$.

If we predict from two parents p_1 and p_2, the formula is:

$$C_c = m_c + \frac{r_{cp_1} - r_{cp_2}r_{p_1p_2}}{1-r^2_{p_1p_2}}\frac{\sigma_c}{\sigma_{p_1}}(C_{p_1} - m_{p_1}) + \frac{r_{cp_2} - r_{cp_1}r_{p_1p_2}}{1-r^2_{p_1p_2}}\frac{\sigma_c}{\sigma_{p_2}}(C_{p_2} - m_{p_2}) \quad \text{...(v)}$$

with a standard deviation for the array of

$$\Sigma_c = \sigma_c\sqrt{\frac{1-r^2_{cp_1} - r^2_{cp_2} - r^2_{p_1p_2} + 2r_{cp_1}r_{cp_2}r_{p_1p_2}}{1-r^2_{p_1p_2}}}.$$

Using these formulae we have the following results*:

A. *Stature.*

For Son:

(1) Probable Stature $= 33''{\cdot}73 + {\cdot}516$ (Father's Stature) $\pm 1''{\cdot}56$,
(2) Probable Stature $= 33''{\cdot}65 + {\cdot}560$ (Mother's Stature)† $\pm 1''{\cdot}59$,
(3) Probable Stature $= 14''{\cdot}08 + {\cdot}409$ (Father's Stature) $+ {\cdot}430$ (Mother's Stature) $\pm 1''{\cdot}42$.

For Daughter:

(4) Probable Stature $= 30''{\cdot}50 + {\cdot}493$ (Father's Stature) $\pm 1''{\cdot}51$,
(5) Probable Stature $= 29''{\cdot}28 + {\cdot}554$ (Mother's Stature) $\pm 1''{\cdot}52$,
(6) Probable Stature $= 10''{\cdot}82 + {\cdot}386$ (Father's Stature) $+ {\cdot}431$ (Mother's Stature) $\pm 1''{\cdot}33$.

* The actual tables of correlation are given in the Appendix and from them it will be seen that all possible pairs were used in each case for determining the correlation. Thus the standard deviations and means vary slightly from table to table, of course well within their probable errors. The formulae here given were, however, obtained by using the means and standard deviations which were adopted for Table I.

† If Father and Mother are to contribute indifferently to Son's stature, the parental statures should be in the ratio of about 560 to 516, which is very nearly the ratio of 1·085 to 1, and almost exactly equal to the 1·083 to 1 of ratio of Father's to Mother's average stature.

B. *Span.*

For Son:

(7) Probable Span = 38″·46 + ·458 (Father's Span) ± 1″·89,

(8) Probable Span = 38″·38 + ·511 (Mother's Span) ± 1″·88,

(9) Probable Span = 18″·04 + ·375 (Father's Span) + ·423 (Mother's Span) ± 1″·70.

For Daughter:

(10) Probable Span = 34″·20 + ·425 (Father's Span) ± 1″·77,

(11) Probable Span = 34″·18 + ·473 (Mother's Span) ± 1″·77,

(12) Probable Span = 14″·70 + ·355 (Father's Span) + ·394 (Mother's Span) ± 1″·61.

C. *Forearm.*

For Son:

(13) Probable Forearm = 10″·65 + ·430 (Father's Forearm) ± ″·60,

(14) Probable Forearm = 10″·88 + ·463 (Mother's Forearm) ± ″·60,

(15) Probable Forearm = 5″·58 + ·362 (Father's Forearm) + ·383 (Mother's Forearm) ± ″·56.

For Daughter:

(16) Probable Forearm = 9″·43 + ·400 (Father's Forearm) ± ″·56,

(17) Probable Forearm = 9″·40 + ·445 (Mother's Forearm) ± ″·56,

(18) Probable Forearm = 4″·50 + ·334 (Father's Forearm) + ·371 (Mother's Forearm) ± ″·51.

On the right is given in each case the probable error of the prediction*. We see from these formulae that with the selection of one parent only, the offspring rise to within 40 to 50 per cent. of the selected value; with the selection of *both* parents to within 70 to 80 per cent. of it. The diminution of the variability of the array due to two selected parents, is however only slightly less than that due to the selection of one parent only.

If we selected for two generations we should have offspring the same very nearly as the selected ancestry†. With our values for parental correlation, it is obvious that two or three generations of selection will suffice to bring the average of the offspring sensibly up to the selected ancestry, and the regression after this,

* In using these formulae for prediction, those not fully conversant with statistical theory, must bear in mind that they give only the mean or most probable results of a whole array of offspring due to *all* parents of definite characters. The validity of the formulae cannot be tested on merely individual cases. This warning is necessary because I have so often had *individual* cases in man or dogs cited as upsetting the whole of the ancestral law!

† "The Law of Ancestral Heredity," *Biometrika*, Vol. II. pp. 221—6.

if the stock mates with its like, will be very small or zero*. We cannot unfortunately on the present material determine absolutely its value; for, in the first place we have no correlations with grandparents or higher ascendants, and in the second place the assortative mating coefficients are so large, that we cannot afford to neglect them to a first approximation, as we have done for the case of eye-colour in man and coat-colour in horses†.

What, however, the present investigation impresses upon one is this: Parental correlation being from ·45 to ·5 in value is much higher than we could anticipate from Mr Galton's *Natural Inheritance* data. Hence selection is far more rapid in its effects than we supposed a few years ago, two to four generations suffice to effect what we originally considered would need 6 to 8. Further, the regression after such selection may well be zero. I have not worked out yet the multiple regression formulae allowing for assortative mating; they present considerable difficulty owing to the complexity introduced by the correlations between relations-in-law due to such mating. But neglecting for a moment the effect of assortative mating, the series of ancestral correlations,

·46 ·32 ·23 ·16

proceeding by a factor ·7 would give a zero-regression and not differ widely from the ancestral correlations we know for eye-colour in man‡. I lay no stress on these particular numbers, but I wish to emphasise the point that a few generations of selection in the case of man suffice to establish a breed, and that regression for this breed may well be insensible.

(viii) *Cross Parental Inheritance.*

I have defined *cross* heredity to be the correlation of two different organs in two blood relations§. We are now for the first time in a position to estimate its magnitude.

We see at once that these coefficients of cross heredity are for some cases almost as large as the coefficients of direct heredity, and on the whole sensibly larger than the values which but a few years ago were supposed to be those of the

* The physical aspect of this is perfectly easy to understand. When we select one parent the offspring advance 35 to 40 p.c. on the general population, when we select two parents 70 to 80 p.c. If we select two parents and four grandparents, there is another percentage increase which brings us up into the 90 per cents., and if we select for three generations we have nearly the 100 per cent. of the required character. Now suppose the selected stock to inbreed or otherwise mate with its likes for this special character. Why will the regression now that selection ceases be zero or insensible? For this simple reason, that while we cease to select within the stock, yet each new generation has an additional selected generation of ancestry behind it, and the influence of this ancestry balances the regressional tendency. This is the simple verbal explanation of the cessation of regression with selection. The algebraical expression of its possibility was first given in my memoir of 1898: see *R. S. Proc.* Vol. 62, p. 401.

† *Ibid.* p. 224. See also *R. S. Proc.* Vol. 62, p. 388.

‡ *Biometrika*, Vol. II. p. 222. ϵ and ρ of p. 224 would be ·56 and ·44 respectively.

§ *Phil. Trans.* Vol. 187, A, p. 259. See also *R. S. Proc.* Vol. 62, p. 410.

direct coefficients. We have thus, if it were needed, still further evidence that the original estimates of the strength of heredity were far too low.

TABLE VI.

Cross Parental Heredity Coefficients.

Parent	Parent's Character	Offspring	Offspring's Character	Correlation and Probable Error
Father ...	Stature	Son	Span	·418 ± ·017
,, ...	Span	,,	Stature	·399 ± ·017
,, ...	Stature	,,	Forearm	·370 ± ·018
,, ...	Forearm	,,	Stature	·355 ± ·018
,, ...	Span	,,	Forearm	·399 ± ·017
,, ...	Forearm	,,	Span	·400 ± ·017
Father ...	Stature	Daughter	Span	·423 ± ·015
,, ...	Span	,,	Stature	·407 ± ·015
,, ...	Stature	,,	Forearm	·341 ± ·016
,, ...	Forearm	,,	Stature	·383 ± ·016
,, ...	Span	,,	Forearm	·382 ± ·016
,, ...	Forearm	,,	Span	·396 ± ·015
Mother ...	Stature	Son	Span	·424 ± ·017
,, ...	Span	,,	Stature	·390 ± ·017
,, ...	Stature	,,	Forearm	·356 ± ·018
,, ...	Forearm	,,	Stature	·344 ± ·018
,, ...	Span	,,	Forearm	·345 ± ·018
,, ...	Forearm	,,	Span	·365 ± ·018
Mother ...	Stature	Daughter	Span	·431 ± ·015
,, ...	Span	,,	Stature	·385 ± ·016
,, ...	Stature	,,	Forearm	·387 ± ·015
,, ...	Forearm	,,	Stature	·318 ± ·016
,, ...	Span	,,	Forearm	·370 ± ·016
,, ...	Forearm	,,	Span	·362 ± ·016

One of the most difficult points to be sure about is the theoretical relationship which is to be expected between the intensities of direct and cross inheritance. If (i) all organs and characters were inherited at the same rate, and (ii) the organic correlations in younger and older generations were the same, and (iii) the variabilities of these generations, as measured by their coefficients of variability, were the same, then it follows that the mean of two corresponding coefficients of cross heredity is the product of the coefficient of direct heredity into the organic correlation*. But none of the three conditions stated above is accurately fulfilled, as we have seen, in the present material. Notably we find sensible divergence from the first. We may possibly attempt to allow for the first disturbing factor in the following manner: the cross-correlations should vanish (a) when the direct

* *R. S. Proc.* Vol. 62, p. 411.

heredity is zero, and again (*b*) when the organic correlations are zero. Hence we might, if 1, 2 represent organs in one of a pair, and 1′, 2′ the same organs in the other of a pair of relatives, expect to find:

$$r_{12'} = c\ r_{11'}r_{1'2'} + c'\ r_{22'}r_{12},$$
$$r_{1'2} = c''r_{22'}r_{1'2'} + c'''r_{11'}r_{12},$$

where c, c', c'' and c''' are at present indeterminate.

Hence:

$$\tfrac{1}{2}(r_{12'} + r'_{1'2}) = r_{1'2'}\left(\frac{cr_{11'} + c''r_{22'}}{2}\right) + r_{12}\left(\frac{c'r_{22'} + c''r_{11'}}{2}\right).$$

Now if heredity were constant for all characters, we should have $r_{11'} = r_{22'}$, and we should reach the above proposition by putting $c = c' = c'' = c''' = \cdot 5$. Thus we should expect the c's to be equal to $\cdot 5$ plus functions of $r_{11'}$, $r_{22'}$, r_{12} and $r_{1'2'}$, which vanish when $r_{11'} = r_{22'}$ and $r_{12} = r_{1'2'}$. What those functions may be it would probably be hard to determine. I therefore propose to write simply

$$\left.\begin{aligned} r_{12'} &= C(r_{11'}r_{1'2'} + r_{22'}r_{12}) \\ r_{1'2} &= C(r_{22'}r_{1'2'} + r_{11'}r_{12}) \end{aligned}\right\} \quad \text{.....(vi)}$$

and determine the values of C. These are given in the Table VII. below. We see at once that C is always greater than $\cdot 5$, its mean value is $\cdot 5683$. If we adopt this value we should have the following *empirical* formula to determine a cross heredity coefficient:

$$r_{12'} = \cdot 5683(r_{11'}r_{1'2'} + r_{22'}r_{12}) \text{.....(vii).}$$

But since the numerical factor is greater than $\cdot 5$, and $r_{11'}$ and $r_{22'}$ as a rule somewhat less, we ought to get *rough* values of the cross coefficients from

$$r_{12'} = \tfrac{1}{4}(r_{1'2'} + r_{12}) \text{ ..... (viii).}$$

The values calculated from these empirical formulae are given in Table VIII. below with the differences.

The probable errors of these coefficients of cross correlations are given in Table VI. Formula (vii) gives 13 values above and 11 below the corresponding probable error. Formula (viii) gives 11 above it and 13 below it. The mean deviation of (vii) is $\cdot 019$ and (viii) is also $\cdot 019$. Thus the formulae are practically equally good so far. But (vii) gives 10 above and 14 below, while (viii) gives only 3 above and 21 below the observed values. Thus as an empirical formula (vii) is somewhat better than (viii), which is really based on the equality of all inheritance coefficients and their approximation to a value of $\cdot 5$, assumptions only roughly true.

Practically either (vii) or (viii) would suffice for most purposes, and the manner in which they smooth the observed results, especially in making what we might *à priori* expect, near equality* between the pairs of corresponding cross correlations is itself an argument in their favour. Hence I should say that when the

* See *R. S. Proc.* Vol. 62, p. 411.

TABLE VII.

Values of C from (vi).

Father	Son	*C*	Father	Daughter	*C*	Mother	Son	*C*	Mother	Daughter	*C*
Stature	Span	·5445	Stature	Span	·5439	Stature	Span	·5711	Stature	Span	·5660
Span	Stature	·5205	Span	Stature	·5250	Span	Stature	·5270	Span	Stature	·5081
Stature	Forearm	·5948	Stature	Forearm	·5425	Stature	Forearm	·6125	Stature	Forearm	·6299
Forearm	Stature	·5727	Forearm	Stature	·6029	Forearm	Stature	·5999	Forearm	Stature	·5280
Span	Forearm	·6039	Span	Forearm	·5729	Span	Forearm	·5553	Span	Forearm	·5840
Forearm	Span	·6057	Forearm	Span	·5934	Forearm	Span	·5914	Forearm	Span	·5741
Means	...	·5737	—		·5634	—		·5762	—		·5650

TABLE VIII.

Calculated and Observed Values of Cross Correlations.

Organs		Father and Son				Father and Daughter				Mother and Son				Mother and Daughter			
		From (vii)		From (viii)		From (vii)		From (viii)		From (vii)		From (viii)		From (vii)		From (viii)	
		Value	Δ	Value	Δ	Value	Δ	Value	Δ	Value	Δ	Value	Δ	Value	Δ	Value	Δ
Stature	Span	·436	−·018	·396	·022	·442	−·019	·403	·020	·422	·002	·390	·034	·433	−·002	·396	·035
Span	Stature	·436	−·037	·396	·003	·441	−·034	·403	·004	·421	−·031	·390	·000	·431	−·046	·396	−·011
Stature	Forearm	·354	·016	·332	·028	·357	−·011	·339	·002	·330	·026	·321	·035	·349	·038	·328	·059
Forearm	Stature	·352	·003	·332	·023	·361	·022	339	·044	·326	·018	·321	·023	·343	−·024	·328	−·010
Span	Forearm	·375	·024	·378	·021	·378	·004	·381	·001	·353	−·008	·359	−·014	·360	·010	·362	·008
Forearm	Span	·375	·025	·378	·022	·379	·017	·381	·015	·351	·014	·359	·006	·358	·004	·362	·000

Δ = Observed − Calculated Value.

organic correlations and direct heredity coefficients are known the cross heredity coefficients may be found very closely from formula (vii). If the organic correlations are known, but no heredity coefficients at all, then the direct heredity coefficients may approximately be taken as equal to ·5 and the cross heredity coefficients approximately found from the organic correlations by formula (viii).

(ix) *Direct Fraternal Resemblance.*

I now turn to the observed degree of resemblance between brothers and sisters for the three characters we have measured in our Family Records. We have the following results:

TABLE IX.

Correlation Coefficients for Direct Fraternal Heredity.

Character	Brother and Brother	Sister and Sister	Brother and Sister	Mean
Stature	·511 ± ·028	·537 ± ·022	·553 ± ·013	·534
Span	·549 ± ·026	·555 ± ·021	·525 ± ·013	·543
Forearm	·491 ± ·029	·507 ± ·023	·440 ± ·015	·479
Mean	·517	·533	·506	·519
Eye Colour*	·517 ± ·020	·446 ± ·023	·462 ± ·022	·475
Total mean	·517	·511	·495	·508

Now there are certain differences in the entries in this Table, thus resemblance in siblings seems greater for stature and span, than for forearm or eye-colour, and again the resemblance of brother and sister seems on the average slightly smaller than the resemblance between siblings of the same sex. There are also certain irregularities, which I have no means of accounting for, and which seem larger than can be explained by random sampling†. Still there cannot be the least doubt from the above table that ·5 measures very closely the average degree of hereditary resemblance in human siblings, and that the correlation clusters closely round this value. As in the case of parental heredity we see a most marked increase in the intensity of hereditary resemblance when we compare our results with those obtained for stature some years ago‡. If we compare our Family Records with the School Records, of which I only cite at present the results for brothers, we

* Francis Galton's eye-colour record reduced for my paper on Heredity in Man in *Phil. Trans.* Vol. 195, A, p. 106.

† The material, as the reader will see by consulting the actual tables, is far less.

‡ *Phil. Trans.* Vol. 187, A, p. 281. It was the difficulties associated with the data used in 1895 (see especially pp. 283—5 of above memoir) that led to the collection of heredity data which has been in progress since 1894.

find good agreement in the ·5 value. In the Table below each series involves 1000 to 2000 cases.

TABLE X.

Fraternal Resemblance in Boys at School.

Character	Correlation	Character	Correlation
General Health... ...	·520	Cephalic Index	·486
Eye Colour	·539	Head Length	·504
Hair Colour	·621	Head Breadth	·593
Straightness of Hair ...	·498	Auricular Height	·554

Mean of Eight Characters ·539.

This compares well with ·517 of the above Family Records for Brothers. At the same time several of the above results are under revision, namely the absolute measurements of the head. In this case every boy was reduced to a standard age 12 by adding to or subtracting from his age the *average* growth found to take place between his age at measurement and the age of 12. A more subtle method of determining the allowance to be made for growth has been recently given by me in a paper published this year, only it involves a very great amount of numerical work, i.e. five instead of two correlation tables, and thus we have only been able so far to modify the correlation in the matter of head length*. I consider it better, however, to place above the correlations as found by one uniform method until we are in position to publish all the results revised. I anticipate that both head breadth and auricular height will ultimately be found to be really nearer to ·5 than appears above. Meanwhile it seems quite safe to sum up our results for fraternal correlation in man as follows:

(i) The degree of resemblance of brethren is closely the same for all characters.

(ii) The two sexes appear to be equally influenced by heredity.

(iii) The intensity of fraternal correlation in man is close to ·5, possibly slightly greater. But for practical purposes we may conveniently work with $\frac{1}{2}$ as a round number.

I now turn to what personally I consider one of the most obscure points in the quantitative determination of inheritance, namely: the manner in which fraternal resemblance varies from species to species, while paternal inheritance remains fairly constant. If we look at Table V. we see that within moderate limits parental influence approximates to the same value for very different species and very diverse characters. This cannot be asserted with the same accuracy of fraternal correlation. I have found values of it ranging from ·4 to ·7 for large and

* *R. S. Proc.* Vol. 71, pp. 290—4.

apparently very trustworthy data for different species. I attribute this, although I have not been able at present to verify it, to *prepotency**. In dealing with prepotency I think it important to distinguish *ab initio* between three kinds: *sex-prepotency*, *unit prepotency*, and *intermittent prepotency*. By *sex-prepotency* I understand that the offspring of one or other sex or of both sexes are more like the male or the female parent as the case may be. Its existence is demonstrated by showing that the correlation for one parent with all the offspring or with one class of offspring is greater than for the other parent. An examination of Table IV. seems to prove that in man for stature, span and forearm there exists no sex-prepotency. On the other hand in eye-colour in man, there does appear to be a *differential* sex-prepotency, fathers are prepotent over mothers for eye-colour in sons, and mothers are prepotent over fathers for the same character in daughters*. If the paternal record were trustworthy in the case of Basset Hounds—which I am very doubtful about—then there would be a large sex-prepotency for all offspring of the dam over sire in coat-colour†. From this sex-prepotency must be distinguished an individual prepotency which I term *unit prepotency*, and which is independent of sex. In unit prepotency one or other unit in a mating is prepotent owing to the possession of some physical character, other than a sexual character. This physical character may or may not be that in which the prepotency shows itself in the offspring. Thus it is conceivable that a dark-eyed parent of either sex might have a unit prepotency over a light-eyed parent, not necessarily in eye-colour or in eye-colour only, but possibly in hair-colour, or stature or mental characters. The unit prepotency may, however, in no way depend upon a simple observable character like this, but on a subtle combination of physical factors producing individual prepotency in one unit of the pair. To demonstrate the latter form of unit prepotency will always be a difficult problem; it could possibly be attacked by considering the reduction of variability in the array of offspring of supposed unit prepotent matings below the average variability of arrays in which such prepotency is supposed not to exist. This method would hardly be possible in the case of man where the number of offspring is too small to get the variability of an array free from a very large probable error. It might be effective in the case of snails, moths, many insects and plants with numerous offspring. When unit prepotency is supposed to be associated with the possession of a definite physical character, it is perfectly possible to attack the problem by the method of association, i.e., investigating the association between the presence (or absence) of this character in a parent and the ratio to total offspring of offspring in the array who do (or do not) possess this character, or some other character of the parent in question. If unit prepotency were absolute we should have the case of "dominance" as originally propounded by Mendel.

While we suppose unit prepotency,—the tendency of one individual out of a pair to be prepotent,—to be *chronic*, there is another form of prepotency which we may describe as *intermittent*. One or other parent may at a particular mating, or

* *Phil. Trans.* Vol. 195, A, p. 106. See also F. Lutz, *Biometrika*, Vol. II. p. 234.

† *R. S. Proc.* Vol. 66, p. 157.

may in certain individual offspring of one and the same mating, be prepotent. On another occasion, or in other offspring of one and the same mating, it may not be prepotent or even the other parent may be prepotent. Such prepotency might exhibit itself in "alternative" or "exclusive" inheritance*, and is distinct from any unit prepotency or absolute or partial dominance. It does not depend on the possession by one mate of certain characters, but on the condition of the parents and other circumstances peculiar to a special mating.

Now the fundamental point to be borne in mind is this, that apart from sex-prepotency, neither unit prepotency nor intermittent prepotency need in any way influence the parental correlations. The average resemblances of offspring to either parent will not be affected if in some matings the mother, in other the father is prepotent. Nor again will it be affected, if occasionally the two parents are intermittently prepotent. But such types of prepotency will largely influence the degree of resemblance between brethren. If, either invariably or intermittently, one parent is prepotent, the offspring of all matings of these parents or the offspring of one litter will be more alike, than the offspring of another species in which such prepotency does not exist. When therefore we find parental correlation the same for a number of species and fraternal correlation different, I am strongly of opinion that this will be found to be due to differing amounts of unit prepotency or of intermittent prepotency or of both combined in diverse species. I have already insisted on this effect of prepotency in disturbing fraternal correlation†, but it seemed necessary again to refer to it as the probable explanation of the great differences observable in the fraternal correlations given below in Table XI.

TABLE XI. *Fraternal Correlation in Different Species.*

Species	Characters	Brother and Brother	Sister and Sister	Sister and Brother	All Siblings
Man	Family Records. Mean of three characters ...	·517	·533	·506	·519
„	Eye Colour	·517	·446	·462	·475
„	School Records. Mean of sixteen characters ...	·520	·519	·518	·519
Basset Hound ...	Coat Colour for same litter	—	—	—	·508
Greyhound‡ ...	Amount of Red in Coat, same litter	·683	·710	·707	·700
„ ...	Amount of Black in Coat, same litter	·642	·680	·659	·660
Thoroughbred Horse	Coat Colour	·623	·693	·583	·633
Daphnia (*Magna*) ...	Ratio of Protopodite to Body Length	—	—	—	·693
Aphis (*Hyalopterus Trirhodus*) ...	Ratio of Right Antenna to Frontal Breadth ...	—	—	—	·589

* *R. S. Proc.* Vol. 66, p. 141, etc. and *Phil. Trans.* Vol. 195, A, p. 89 *et seq.*

† *R. S. Proc.* Vol. 66, p. 152, and *Phil. Trans.* Vol. 195, A, p. 101.

‡ Unpublished results, tabled by Miss A. Barrington from Mr Howard Collins' data, reduced by Dr A. Lee.

I have not placed in this table the results for stature as found from Mr Galton's Family Data, nor those for Cephalic Index for North American Indians, because I consider that the results for both these characters are replaced by the larger series we have now at our disposal, and which are included under "man" in the above list. Otherwise it embraces nearly all the data we have as yet at our disposal. Now it is clear that the value for man is about ·5 and agrees well with the value found for Basset Hounds, and indeed with that for the Shirley Poppy, assuming complete cross fertilisation*. On the other hand the horses and greyhounds, *while agreeing well with man for the parental correlations* (see Table V. p. 23), show a much increased fraternal correlation of the same order as that between the parthenogenetic offspring of Daphnia and Aphis†. Now how far is this due to such factors as unit prepotency or intermittent prepotency? All we can do at present is to suspend our judgment on this point. In the case of dogs, intermittent prepotency might manifest itself by the offspring of the same parents for the same litter being more alike than for different litters. Now will this account for the high values of the greyhound results? Unfortunately our records contain only greyhounds of the *same* litter, all members being recorded, while the volumes of the greyhound stud-book contain only a *selection* of all dogs born, colour undoubtedly being a selected character. Further it is very difficult from those volumes to extract a sufficient number of brethren of full blood from different litters. Still we hope to be able to throw some light on the problem of at least intermittent prepotency in the case of greyhounds. It is remarkable that the fraternal correlation in the Basset Hounds, while according closely with that in man, is the same sensibly in intensity for siblings from the same and from different litters. The case of the thoroughbred horses is somewhat different, but here we propose to draw up separate tables for twin foals and foals from the same parents in different years, and thus if possible differentiate intermittent prepotency, if it really exists. The high values, however, found for half-siblings in the case of the thoroughbreds seem to indicate that we must look rather to unit prepotency than intermittent prepotency for the source of the high value of fraternal as compared with parental correlation in the case of the horse.

What is quite clear is that we badly want the *measurement* of further characters for siblings in both mammals and insects. The present results show that while the value ·5 has overwhelming evidence for it in the case of both measurable and unmeasurable characters in man, we are yet without like data for the measurable characters in horse, dog or any other mammal. Should these ultimately be found to agree with the results given above for the quantitatively unmeasurable characters, I personally hold at present, that the solution for equal parental and unequal fraternal correlations in these different species should first be sought in a fuller study of unit and intermittent prepotency.

* *Biometrika*, Vol. II. p. 81.

† In the case of these insects differential environment may, of course, have emphasised the resemblance.

(x) *Cross Fraternal Resemblance.*

I turn to the relationships between different organs in pairs of siblings. These are tabulated below.

TABLE XII.

Correlation Coefficients for Cross Fraternal Heredity.

1st Sibling	Character	2nd Sibling	Character	Correlation and Probable Error
Brother	Stature	Brother	Span	·444 ± ·021
„	Stature	„	Forearm	·368 ± ·023
„	Span	„	Forearm	·451 ± ·021
Sister	Stature	Sister	Span	·471 ± ·017
„	Stature	„	Forearm	·438 ± ·018
„	Span	„	Forearm	·453 ± ·017
Brother	Stature	Sister	Span	·478 ± ·014
„	Span	„	Stature	·456 ± ·014
„	Stature	„	Forearm	·399 ± ·015
„	Forearm	„	Stature	·412 ± ·015
„	Span	„	Forearm	·419 ± ·015
„	Forearm	„	Span	·423 ± ·015

The same general remark must again be made here, i.e. these cross-correlations are remarkably high,—as high as a few years ago we anticipated that the direct fraternal correlations would be.

The series being rather short—three to four hundred brothers*—the results are more irregular than we might have hoped for. In particular the cross-correlation between brother's stature and brother's forearm is distinctly less than we might have expected. A result of slightly over ·4 would clearly be more consonant with the other results, but I have not been able to discover any slip in the arithmetic. In the brother-sister correlations we find that within the limits of the probable errors of random sampling the cross-correlation coefficients are pair and pair equal, e.g. the relation of brother's stature to sister's forearm is sensibly that of brother's forearm to sister's stature.

To obtain an empirical formula, I assumed that as in (vi) p. 385 we should have

$$r_{12'} = C\,(r_{11'}r_{1'2'} + r_{22'}r_{12}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(ix)}.$$

I determined C from the twelve series and found for its mean value ·5585. This is within two per cent. of the value of C found for the cross-parental relationships, and I think the agreement is as close as we could hope for†.

* See Appendix of correlation tables.

† To obtain the desirable end of using one formula instead of two. I am not convinced that equality is *à priori* to be expected.

Using the formula

$$r_{1g'} = \cdot 5585\,(r_{11'}r_{1'g'} + r_{2'}r_{12}) \quad \ldots\ldots\ldots\

TABLE XIII.

Observed and Calculated Values of Cross Fraternal Coefficients.

Pair of Characters	Brother and Brother				Sister and Sister				First Brother and Second Sister			
	From (vii)		From (x)		From (vii)		From (x)		From (vii)		From (x)	
	Calculated	Δ	Calculated	Δ	Calculated	Δ	Calculated	Δ	Calculated	Δ	Calculated	Δ
Stature and Span ...	·483	− ·039	·475	− ·031	·514	− ·043	·505	− ·034	·499	− ·021	·491	− ·013
Span and Stature ...	—	—	—	—	—	—	—	—	·499	− ·043	·490	− ·034
Stature and Forearm	·391	− ·023	·384	− ·016	·425	+ ·013	·417	+ ·021	·397	+ ·002	·390	+ ·007
Forearm and Stature	—	—	—	—	—	—	—	—	·395	+ ·017	·388	+ ·024
Span and Forearm ...	·448	+ ·003	·440	+ ·011	·432	+ ·021	·425	+ ·028	·420	− ·001	·412	+ ·007
Forearm and Span ...	—	—	—	—	—	—	—	—	·419	+ ·004	·412	+ ·011

Δ = Observed − Calculated Value.

the range of new problems which suggest themselves for solution. Yet I think each large mass of material statistically reduced places a further stratum of firm ground beneath us. In particular, this first paper on inheritance of the physical characters in man, has, I hold, enabled us to reach some very definite results. Indeed, I believe them sufficient repayment for the years spent by my helpers in measuring upwards of a thousand families and tabling and reducing the data*. Of the special results obtained I would refer in particular to the following.

(i) We have very definite evidence that the normal curve suffices to describe within the limits of random sampling the distribution of the chief physical characters in man.

This confirms the conclusions of Galton, Macdonell, Fawcett and other workers in anthropometry, and is of special value when we come to extend our results to the inheritance of characters not quantitatively measurable.

(ii) The regression curve between pairs of blood relations, whether we deal with direct or cross-heredity, is within the limits of random sampling *linear*. This had been already suggested by Galton on the basis of the theory of normal distribution, and confirmed by his researches on stature. I think we may safely assume in future that the dimensions of the human body give linear regression-lines†.

(iii) There is an apparent change in type going on in man, especially evidenced in the female, but also sensible in the male. The young adult differs in magnitude, variability and correlation from the old adult and the difference appears to be significantly beyond growth changes.

We cannot at present determine whether this change is:

(*a*) Environmental, due to change in physical training and food between the young and old generations.

(*b*) Due to natural selection, the young adults being reduced nearer to the old adult type by deaths of a selective character in the intervening 20 to 30 years. If the change of type is due to a selective death rate, it may be either periodic, occurring in each generation, or secular, i.e., a progressive change.

(*c*) Due to reproductive selection, out of young adults a certain class have a differential fertility and become in bulk the parents of adult offspring.

But although we are not in a position to effectually discriminate at present between the amount of change due to (*a*), (*b*) and (*c*), our results immensely emphasise the view that even in apparently unessential characters mankind is, even at the present day, not in a stable condition, but that a change of type is very probably taking place owing to natural or reproductive selection or environmental

* When it is remembered that the whole work of measurement was done by volunteer aid, and without assistance from any public fund, I think other workers may take heart, who imagine that problems in heredity are necessarily confined to extensive breeding experiments of an expensive nature.

† This is really a very important point. In a forthcoming memoir on skew correlation, I deal with non-linear regression and show how fairly frequent it is and how complex it renders the treatment of correlation.

influence, and the change is of a magnitude, which would accumulate, if it be secular, within a comparatively few centuries into most significant differences.

(iv) There is a quite unexpected amount of sexual selection even of the physical characters in man. There is probably preferential mating, there is most certainly a large amount of assortative mating, and this not only in the same but in cross characters. The *modus operandi* of this assortative mating is not clear; it can hardly in any great part be due to conscious selection; it may be the result of reproductive selection, i.e. a subtle combination of physical characters in male and female being most likely to give a pair with a number of adult children. Be the source what it may, the existence of this assortative mating most substantially modifies the form of biparental inheritance, and its existence can hardly in future be neglected when we are considering the problems of heredity.

(v) The coefficient of parental heredity varies to some extent from character to character in man, having a mean value of about ·46. This value is, however, in quite close agreement with the results obtained for other species, and we may roughly say that parental heredity in the species hitherto dealt with is close to ·5.

(vi) Fraternal correlation for the physical characters of man dealt with in this memoir is also close to ·5. This is in good agreement with the result obtained for eight physical and eight mental characters compared in pairs of brothers in schools. While, however, parental correlations are in good accord for different species, fraternal correlations in such species have a much wider range. This curious result is being further considered, but the tentative suggestion is made that it is due either to different degrees of unit or of intermittent prepotency in the members of these species.

(vii) For the first time in this paper statistics of an extensive kind are given for answering the problems of cross heredity, and an empirical formula is given for determining cross heredity from direct heredity and organic correlations. Some years ago, I proposed for cross heredity a formula which amounted in the notation of the present memoir to

$$r_{12'} = \tfrac{1}{2}\,(r_{11'}\, r_{1'2'} + r_{22'}\, r_{12})$$

where 1, 2 are the organs in the first, 1′, 2′ the like organs in the second relative. This formula was based on a theory involving the constancy of the heredity coefficient for all characters (cf. (v) above). It is shown in the present paper that on the average $\frac{1}{2}$ must be replaced by ·57 for parental and by ·56 for fraternal cross correlations. With these numbers we obtain from the direct and organic correlations values of the cross heredity coefficients well within the errors of random sampling. Thus at any rate in the case of man, we are in a position to determine cross-heredity for the physical characters without direct investigation. A further research on cross-heredity will, I hope, shortly be published.

(viii) The values of the parental correlations determined for man, show that two or three generations of selection would suffice to raise the mean of the offspring to the selected standard. Further with quite reasonable values of the grandparental correlations no regression would take place, and the stock breed true.

The result is of extreme importance, for two reasons:

(*a*) It illustrates the absurdity of the prevalent biological conceptions of regression as a constant factor, only restrained by the action of persistent selection.

(*b*) It emphasises the all-important law that with judicious mating human stock is capable of rapid progress. A few generations suffice to modify a race of men, and the nations which breed freely only from their poorer stocks will not be dominant factors in civilisation by the end of the century.

APPENDIX OF CORRELATION TABLES.

Organic Correlations.

		PAGE
i.	Stature and Span in Fathers	399
ii.	„ „ Mothers	399
iii.	„ „ Sons	400
iv.	„ „ Daughters	401
v.	Span and Forearm in Fathers	402
vi.	„ „ Mothers	402
vii.	„ „ Sons	403
viii.	„ „ Daughters	404
ix.	Forearm and Stature in Fathers	405
x.	„ „ Mothers	405
xi.	„ „ Sons	406
xii.	„ „ Daughters	407

Direct Assortative Mating Correlations.

xiii.	Statures of Fathers and Mothers	408
xiv.	Spans „ „	409
xv.	Forearms „ „	410

Cross Assortative Mating Correlations.

xvi.	Stature of Father and Span of Mother	410
xvii.	„ „ Forearm „	411
xviii.	Span „ Stature „	412
xix.	„ „ Forearm „	413
xx.	Forearm „ Stature „	414
xxi.	„ „ Span „	414

Direct Parental Correlations.

xxii.	Stature of Father and Son	415
xxiii.	Spans „ „	416
xxiv.	Forearms of Father and Son	417
xxv.	Statures „ Daughter	417
xxvi.	Spans „ „	418
xxvii.	Forearms „ „	419
xxviii.	Statures of Mother and Son	419
xxix.	Spans „ „	420
xxx.	Forearms „ „	420
xxxi.	Statures of Mother and Daughter	421
xxxii.	Spans „ „	422
xxxiii.	Forearms „ „	423

Cross Parental Correlations.

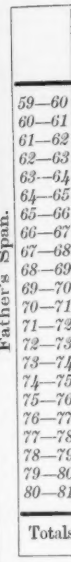
		PAGE
xxxiv.	Father's Stature and Son's Span	423
xxxv.	„ Span „ Stature	424
xxxvi.	„ Stature „ Forearm	425
xxxvii.	„ Forearm „ Stature	425
xxxviii.	„ Span „ Forearm	426
xxxix.	„ Forearm „ Span	427
xl.	Father's Stature and Daughter's Span	428
xli.	„ Span „ Stature	429
xlii.	„ Stature „ Forearm	430
xliii.	„ Forearm „ Stature	431
xliv.	„ Span „ Forearm	432
xlv.	„ Forearm „ Span	433
xlvi.	Mother's Stature and Son's Span	434
xlvii.	„ Span „ Stature	435
xlviii.	„ Stature „ Forearm	435
xlix.	„ Forearm „ Stature	436
l.	„ Span „ Forearm	437
li.	„ Forearm „ Span	438
lii.	Mother's Stature and Daughter's Span	439
liii.	„ Span „ Stature	440
liv.	„ Stature „ Forearm	441
lv.	„ Forearm „ Stature	442
lvi	„ Span „ Forearm	443
lvii.	„ Forearm „ Span	444

Direct Fraternal Correlations.

lviii.	Brothers' Statures	444
lix.	Brothers' Spans	445
lx.	Brothers' Forearms	445
lxi.	Sisters' Statures	446
lxii.	Sisters' Spans	447
lxiii.	Sisters' Forearms	447
lxiv.	Brother's and Sister's Statures	448
lxv.	„ „ Spans	449
lxvi.	„ „ Forearms	450

Cross Fraternal Correlations.

lxvii.	Brother's Stature and Brother's Span	451
lxviii.	„ „ „ Forearm	452
lxix.	„ Span „ Forearm	453
lxx.	Sister's Stature and Sister's Span	454
lxxi.	„ „ „ Forearm	455
lxxii.	„ Span „ Forearm	456
lxxiii.	Brother's Stature and Sister's Span	457
lxxiv.	Sister's Stature and Brother's Span	458
lxxv.	Brother's Stature and Sister's Forearm	459
lxxvi.	Sister's Stature and Brother's Forearm	460
lxxvii.	Brother's Span and Sister's Forearm	461
lxxviii.	Sister's Span and Brother's Forearm	462



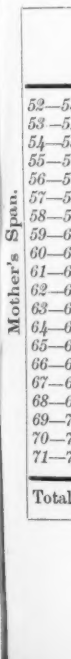


TABLE I.

Father's Stature and Span (Organic).

Father's Stature.

Father's Span.	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	Totals
59—60	·25	·25	·5	—	—	—	—	·5	·5	—	—	—	—	—	—	—	—	—	2
60—61	·25	1	1·75	1	·5	·75	·25	·5	·5	—	—	—	—	—	—	—	—	—	6·5
61—62	—	·75	·5	2	2·5	·2	1·25	1·25	·25	—	—	—	—	—	—	—	—	—	10·5
62—63	—	—	·25	2	5·25	3·5	1	3·75	·75	—	—	—	—	—	—	—	—	—	16·5
63—64	—	·25	·25	1	5	7	7	4	2·75	·25	·5	—	—	—	—	—	—	—	28
64—65	—	·25	·75	1·25	9·75	12·5	13·25	16	5·75	2	1·5	—	·5	—	—	—	—	—	63·5
65—66	—	—	·5	·5	4	5·75	15·5	20	12·75	6·25	2	2·5	1·25	—	—	—	—	—	71
66—67	—	—	—	·5	3	4	15·75	24·75	35·75	16·75	10·25	1·75	1·5	—	—	—	—	—	114
67—68	—	—	—	.25	1·75	2·75	10·25	20·25	31	27·5	21·25	10·5	2·75	1·25	—	—	—	—	129·5
68—69	—	—	—	—	·5	2·5	5·75	18·25	27	29	31·75	14·25	7	1·5	—	·5	·5	—	138·5
69—70	—	—	—	—	·25	1·25	·75	7	12·25	25	38·25	23	15·75	3	—	—	—	—	126·5
70—71	—	—	—	—	—	·5	·25	4	7·5	21·25	24·5	24	15·25	8·5	3·25	—	—	—	109
71—72	—	—	—	—	—	—	·25	1·5	4·25	4·25	13·75	16·25	19·5	13·5	6·25	·5	—	—	80
72—73	—	—	—	—	—	—	·25	·5	1	2	6·75	15·75	19·5	12·75	6·75	1·75	—	—	67
73—74	—	—	—	—	—	—	—	·25	5	1·25	4	7	8	6·75	4·25	3·5	2	·5	38
74—75	—	—	—	—	—	—	—	—	—	—	—	3·5	7	3·75	5·5	2·25	—	·5	22·5
75—76	—	—	—	—	—	—	—	—	—	—	—	—	2·5	4	4·5	3	1	1·5	16·5
76—77	—	—	—	—	—	—	—	—	—	·5	—	—	1·5	·5	1	·75	1·25	·5	6
77—78	—	—	—	—	—	—	—	—	—	·5	—	—	·5	—	—	·25	·25	—	1·5
78—79	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	2
79—80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
80—81	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	·5	—	—	1
Totals	·5	2·5	4·5	8·5	32·5	42·5	71·5	122·5	142·5	136·5	154·5	118·5	102·5	56·5	33	13	5	3	1050

TABLE II.

Mother's Stature and Span (Organic).

Mother's Stature.

Mother's Span.	52—53	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	Totals
52—53	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
53—54	—	—	—	—	—	·25	·75	·5	—	—	—	—	—	—	—	—	—	—	—	1·5
54—55	—	—	—	·25	·25	·75	·75	—	·5	—	—	—	—	—	—	—	—	—	—	2·5
55—56	·5	·5	—	·75	1·5	2·5	2·25	1·25	1·25	1	—	—	—	—	—	—	—	—	—	11·5
56—57	—	—	·5	·5	1·75	5	4·75	8·25	2·75	1·5	1·25	·25	—	—	—	—	—	—	—	26·5
57—58	—	—	·5	·5	1·5	6·25	6·5	8·75	9	4	2·5	·5	—	—	—	—	—	—	—	40
58—59	—	—	—	—	·5	1·25	6·25	18·25	20·25	13·25	7·75	2·25	·25	1	—	—	—	—	—	71
59—60	—	—	—	—	1	1·75	9	15·75	35·25	33·5	15·25	9·25	1·25	·25	·25	1	—	—	—	123·5
60—61	—	—	—	—	—	·25	2·5	16	35	35·75	29·5	12·5	2·75	1	1·75	1	—	—	—	138
61—62	—	—	—	—	—	—	·75	5·25	19·5	34·75	42	28·25	10	5·75	2·75	—	—	—	—	149
62—63	—	—	—	—	—	—	·75	3·25	6	22	42·5	40	23·75	6·75	3	·5	—	—	—	148·5
63—64	—	—	—	—	—	—	·25	1·25	2·75	10·75	24·25	34·5	30	14·25	3	·5	—	—	—	121·5
64—65	—	—	—	—	—	—	—	·5	1·5	3·5	11·25	23·25	24·25	19	6·5	1·75	—	—	—	91·5
65—66	—	—	—	—	—	—	—	·5	·75	1	5·25	8·75	10·5	15·5	14·5	2·5	·25	—	—	59·5
66—67	—	—	—	—	—	—	—	—	·75	·75	·5	1·5	7	6·75	5	3	1·25	—	—	26·5
67—68	—	—	—	—	—	—	—	—	·25	·25	—	1	2·5	4	3·5	2·5	2	—	—	16
68—69	—	—	—	—	—	—	—	—	—	·5	·5	1	1	1·5	·75	1·75	2	2·5	—	11·5
69—70	—	—	—	—	—	—	—	—	—	·5	·5	—	·75	2·25	—	1·25	1·75	1	·5	8·5
70—71	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	—	·25	·25	1	1·5	3·5
71—72	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	·5
Totals	1·5	·5	1	2	6·5	18	34·5	79·5	135·5	163	183	163	114·5	78·5	41	16	7·5	4·5	2	1052

TABLE III.

Brother's Stature and Span (Organic).

Brother's Stature.

Brother's Span.	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	*72—73*	*73—74*	*74—75*	*75—76*	*76—77*	*77—78*	*78—79*	*79—80*	Totals
58—59	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
59—60	·25	1·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1·5
60—61	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
61—62	·25	·75	·5	1·25	·25	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	3·5
62—63	—	—	—	1·25	·25	1	—	—	1·25	·25	—	·25	·25	—	—	—	—	—	—	—	—	4·5
63—64	—	—	·5	1·5	5·25	2·5	2·25	1	—	—	—	·25	·25	—	—	—	—	—	—	—	—	13·5
64—65	—	—	·5	—	4·5	8·25	4·75	6	6	2	—	—	—	—	—	—	—	—	—	—	—	32
65—66	—	—	—	1	7·5	13·75	13·75	15·25	7·75	3·5	2	·5	·5	—	—	—	—	—	—	—	—	65·5
66—67	—	—	—	1	6·5	12	21·75	19	17·25	4·5	1·5	·5	·5	—	—	—	—	—	—	—	—	84·5
67—68	—	—	—	1·75	5	11·5	17·5	32·25	23	12·75	1·75	1	—	—	—	—	—	—	—	—	—	106·5
68—69	—	—	—	·75	1·75	6	9	21·5	43·5	31	13·5	3	2	—	—	—	—	—	—	—	—	132
69—70	—	—	—	·5	—	1	6·75	21	39	44	29	12·75	1·5	·5	—	—	—	—	—	—	—	156
70—71	—	—	—	·5	—	—	2·25	7·25	23·75	37·25	33	32·75	11·25	1·5	·5	·5	·5	—	—	—	—	151
71—72	—	—	—	—	—	—	—	2·5	9	30·75	19·5	33·25	22	5·25	3·25	1	·5	—	—	—	—	127
72—73	—	—	—	—	—	—	·25	·5	4·75	13	17	29·75	18·25	13	4·25	1·5	·25	—	—	—	—	102·5
73—74	—	—	—	—	—	—	·25	·75	3	6·5	8	17·75	17·5	11·5	7·5	3·5	·25	—	—	—	—	76·5
74—75	—	—	—	—	—	—	—	—	—	1·75	8·25	3·5	11	12·25	7·75	3·5	·5	—	—	—	—	48·5
75—76	—	—	—	—	—	—	—	—	—	1·5	1·25	1	5·25	5	9	2	1	·5	—	—	—	26·5
76—77	—	—	—	—	—	—	—	—	—	—	·25	·75	2	3	2	2·5	·5	1·5	—	—	—	12·5
77—78	—	—	—	—	—	—	—	—	—	—	1	—	·75	·5	4·25	1·5	·5	·5	—	—	—	9
78—79	—	—	—	—	—	—	—	—	—	—	1	—	—	—	·5	·75	2·25	1	·5	·5	—	6·5
79—80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	—	·25	·75	—	1·5
80—81	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·75	—	1
81—82	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Totals	1	2·5	1·5	9·5	31	56	78·5	127	178·5	189	137	137	93	52·5	39	17	6·5	3·5	1	2	1	1164

TABLE IV.

Sister's Stature and Span (Organic).

Sister's Stature.

Sister's Span.	52—53	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	Totals
53—54	—	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	1	1	·25	·25	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	3
55—56	—	—	—	—	—	1	·5	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	2
56—57	—	—	—	1	1·25	2·5	1·25	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6·5
57—58	—	—	—	—	·5	2·75	3	3·5	6·75	2·5	·5	—	—	—	—	—	—	—	—	—	—	—	19·5
58—59	—	—	—	—	1·5	4·25	5·25	17·5	14·75	7·25	2	·75	·25	—	—	—	—	—	—	—	—	—	53·5
59—60	—	—	—	—	·75	2·25	3·25	15·25	27·75	18·75	13·75	7·25	3·5	—	—	—	—	—	—	—	—	—	92·5
60—61	—	—	—	—	—	1·25	·5	6·75	25·75	39·75	38	14	6·75	1·25	—	·5	·5	—	—	—	—	—	135
61—62	·5	·5	—	—	—	—	1·25	6·25	14·25	33·5	53	34	14	6	1·25	—	—	—	—	—	—	—	164·5
62—63	—	—	—	—	—	—	—	1·75	8·5	26·75	44·75	59	29·75	12·25	6·5	1·25	—	—	—	—	—	—	190·5
63—64	—	—	—	—	—	—	—	—	1	16·25	30·5	58·25	52·25	22·25	11·25	3·25	·5	—	—	—	—	—	195·5
64—65	—	—	—	—	—	—	—	—	·75	3·5	9·5	28·25	54·75	45·75	25·25	8·25	·5	—	·25	·25	—	—	177
65—66	—	—	—	—	—	—	—	—	·5	1·5	4·75	15·75	34	51·5	26·75	11·25	3·25	·5	·5	·25	—	—	150·5
66—67	—	—	—	—	—	—	—	—	—	·25	1·25	3·75	14·75	17·75	31·5	15·75	8·75	2	·25	—	—	—	96
67—68	—	—	—	—	—	—	—	—	—	—	1	1·5	4	6·25	27·25	19·75	11	1·75	·5	—	—	—	73
68—69	—	—	—	—	—	—	—	—	—	—	—	·5	1	3·5	13·25	11·25	10	6·5	3	·5	—	—	49·5
69—70	—	—	—	—	—	—	—	—	—	—	—	—	—	2	6·75	6·75	4·25	5·75	1·5	·5	—	—	27·5
70—71	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1·75	2·5	1·75	2	1·75	·25	—	—	11
71—72	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	·75	2	2·25	—	—	6
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	—	—	—	·5
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
74—75	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	·5	1
75—76	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	·5	1
Totals	·5	·5	—	1	5	15	15·5	52	101	150	199	223	215	169·5	151·5	81·5	40·5	19·5	10	5	—	1	1456

TABLE V.

Father's Forearm and Span (Organic).

Father's Forearm.

Father's Span.	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
59—60	—	·5	·25	·75	·5	—	—	—	—	—	—	—	—	—	—	2
60—61	—	1·25	2	1·25	2	—	—	—	—	—	—	—	—	—	—	6·5
61—62	—	1	1·25	3·5	4·25	—	—	·25	·25	—	—	—	—	—	—	10·5
62—63	—	1	3	4·75	4	1·25	·5	·25	·5	·25	—	—	—	—	—	15·5
63—64	·25	·75	2·5	6·75	10·75	5·25	1	·25	·25	·25	—	—	—	—	—	28
64—65	·25	·5	3	15·25	23	14·5	4·75	1·75	—	—	—	—	—	—	—	63
65—66	—	—	·25	5·75	23·75	28·5	11	3	1·25	—	—	—	—	—	—	73·5
66—67	·5	·75	·75	6	32·25	37·5	28	7	1·25	—	—	—	—	—	—	114
67—68	—	·5	2·75	3·25	15	45·25	42	14·5	4·5	1	·75	—	—	—	—	129·5
68—69	—	·25	·25	·75	5·75	32·75	54·75	26·25	11	2·5	·75	1	—	·5	·5	137
69—70	—	—	·5	1	3·75	20	43·75	33·25	19·25	4·5	·5	·5	—	—	—	127
70—71	—	—	·5	—	·5	11·75	33·5	37·75	19·5	3·5	1·5	·25	·25	—	—	109
71—72	—	—	—	—	—	2	11·5	32·25	20·5	7	2·25	1	·5	·25	·75	78
72—73	—	—	—	—	—	·75	3·75	18·5	24	12·5	5·5	·75	1	·5	·75	68
73—74	—	—	—	—	—	·5	1	6	14·75	9	5·75	·25	·5	·25	—	38
74—75	—	—	—	—	—	—	—	1·5	6·25	7·5	5·5	1	·25	·25	·25	22·5
75—76	—	—	—	—	—	—	—	—	2·25	5	6·5	2·25	·5	·25	·25	17
76—77	—	—	—	—	—	—	—	·5	1·5	3·25	1	·25	—	—	—	6·5
77—78	—	—	—	—	—	—	—	·5	—	·25	·5	·25	—	—	—	1·5
78—79	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	2
79—80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80—81	—	—	—	—	—	—	—	—	—	—	—	·5	·5	—	—	1
Totals	1	6·5	17	49	125·5	200	235·5	183·5	127	57·5	31·5	8	3·5	2	2·5	1050

TABLE VI.

Mother's Forearm and Span (Organic).

Mother's Forearm.

Mother's Span.	13—13·5	13·5—14	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	Totals
52—53	—	·5	·5	—	—	—	—	—	—	—	—	—	—	—	1
53—54	—	·25	·25	1	—	—	—	—	—	—	—	—	—	—	1·5
54—55	—	·25	·25	1·25	1	·25	—	—	—	—	—	—	—	—	3
55—56	—	—	—	1·25	5·25	5	·5	—	—	—	—	—	—	—	12
56—57	—	—	1·25	6·25	9·75	4·25	1·75	2·5	·75	—	—	—	—	—	26·5
57—58	—	—	1·5	4	10·75	12	6·75	4	1·5	—	—	—	—	—	40·5
58—59	·25	·25	1·25	5·5	12·5	24	15·75	7	2·5	·75	·25	—	—	—	70
59—60	·25	·25	1·25	4	14	42·25	40·75	12·5	3·5	1·5	1	·5	·25	—	122
60—61	—	—	·25	2	7	44	51	26·25	5·25	1·25	1·25	·5	·25	—	139
61—62	—	—	·5	1·75	3·75	20·5	55	43·75	17·5	4·5	1·25	—	—	—	148·5
62—63	—	—	—	1·25	2·25	10·25	46	52·25	27·25	6·75	2	—	—	—	148
63—64	—	—	—	·5	1·25	5·5	26·25	41·25	35·5	7·25	3	—	—	—	120·5
64—65	—	—	—	·25	·5	3·25	6·5	30	31·75	14·75	3·5	1·25	1·75	—	93·5
65—66	—	—	—	—	—	2	2	10·75	21·75	15·5	5·75	1·5	·25	—	59·5
66—67	—	—	—	—	—	·25	·25	2·75	7·25	8·25	7	·5	·25	—	26·5
67—68	—	—	—	—	—	—	—	1	4·5	5·25	3·25	2·25	·25	—	16·5
68—69	—	—	—	—	—	—	1	1·25	1·25	3·25	3	1	·25	—	11
69—70	—	—	—	·25	·25	—	—	·25	·5	1·25	2·75	1·75	1	—	8
70—71	—	—	—	·25	·25	·25	·25	—	·25	·25	1	·25	·75	·5	4
71—72	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	·5
Totals	·5	1·5	7	29·5	68·5	174	254	235·5	161	70·5	35	9·5	5	·5	1052

TABLE VII.

Son's Span and Forearm (Organic).

Son's Span.

Son's Forearm.	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	81—82	Totals
14—14·5	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
14·5—15	—	—	·25	·25	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
15—15·5	—	—	·25	·25	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
15·5—16	—	—	—	—	—	·25	1·5	1·75	—	·75	·75	—	·25	·25	—	—	—	—	—	—	—	—	—	—	5·5
16—16·5	—	—	—	·5	1	1·75	·75	2·5	·25	1	·75	—	·5	·5	·25	·25	—	—	—	—	—	—	—	—	10
16·5—17	·25	·25	—	1·5	1·5	6·25	5	10·25	6·25	3·75	1·25	1	·5	·5	·75	·5	—	—	—	—	—	—	—	—	39·5
17—17·5	·25	·25	—	·25	·75	3·25	11	19·5	27·25	14·25	9·75	4·25	2	1·5	·5	·25	—	—	—	—	—	—	—	—	95
17·5—18	—	—	—	·5	·5	1	7·5	19·75	27·75	39	39	27·25	8·75	3·75	1·75	1	—	—	—	—	—	—	—	—	177·5
18—18·5	—	—	—	·25	·25	·5	3·75	6·75	14·5	35	52	64	42·75	25·25	9·25	5·25	·5	·25	·25	—	—	—	—	—	260·5
18·5—19	—	—	—	—	—	—	·5	1·75	5	8	20·75	39·5	58·5	37·5	31	14·25	5·5	1·5	·5	·25	·5	—	—	—	225
19—19·5	—	—	—	—	—	—	—	1·25	2·25	3	6·25	10·5	30	34·75	33·75	23	15	3·25	1·75	·75	1	—	—	—	166·5
19·5—20	—	—	—	—	—	—	—	·75	1	·25	1	4	8	16·5	17·5	22·5	17·75	11·75	2	1·5	·5	—	—	—	105
20—20·5	—	—	—	—	—	—	—	·25	·25	—	·75	1·75	·75	3·5	6	8·25	5·75	6·25	4·5	2·25	·5	·25	—	—	41
20·5—21	—	—	—	—	—	—	—	—	—	—	·25	·75	—	·25	1	1	2	3·25	1·5	2	1·75	·5	·25	—	14·5
21—21·5	—	—	—	—	—	—	—	—	—	—	—	·5	—	·25	·25	·25	1	·75	·5	1·75	1·5	·5	·25	—	7·5
21·5—22	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	1·25	·25	—	1	4·5
22—22·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
22·5—23	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
23—23·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	·5	—	—	—	—	1
Totals	·5	·5	·5	3·5	4	13	32	64·5	84·5	105	132·5	153·5	152	125·5	102	76·5	47·5	28	11·5	9	7	1·5	·5	1	1156

TABLE VIII.

Sister's Span and Forearm (Organic).

Sister's Span.

Sister's Forearm.	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	Totals
13·5—14	·25	·25	—	—	—	·25	·25	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1·5
14—14·5	·25	1·25	—	—	—	·75	1·25	·25	·75	·5	—	—	1	—	—	—	—	—	—	—	—	—	—	6
14·5—15	—	1·25	1·5	2·75	2·75	3·5	2·5	2	·5	1·25	—	·5	·5	—	—	—	—	—	—	—	—	—	—	19
15—15·5	—	·25	·5	2·25	8·25	19·25	17·75	12·25	5·5	3	—	—	·75	·25	—	—	—	—	—	—	—	—	—	70
15·5—16	—	—	—	1·25	3	21·75	35	43·75	42·5	22·75	8·5	1·5	2·5	·75	·25	·5	—	—	—	—	—	—	—	184
16—16·5	—	—	—	1	4·25	6·25	24·75	55	63·25	75·75	54	19·5	11·5	1·75	2	1	—	—	—	—	—	—	—	320
16·5—17	—	—	—	·25	1	1	6	19	39·5	57	76·75	67	33·75	15	2	·25	—	—	—	—	—	—	—	318·5
17—17·5	—	—	—	—	·25	·75	2·5	4·75	11·75	24·75	42·5	62·75	52·5	36·5	15	4·75	2·5	·25	—	—	—	—	—	261·5
17·5—18	—	—	—	—	—	—	·5	·5	·25	3·75	10	16·5	33·75	29·75	34·5	21·25	7·5	1·25	—	—	—	—	—	159·5
18—18·5	—	—	—	—	—	—	—	—	—	1·5	3·5	8·75	11·25	10·5	14·75	13·75	8·25	3·75	2·5	·5	—	—	—	79
18·5—19	—	—	—	—	—	—	—	—	—	·75	1	·25	·25	1·25	4·75	5·75	6·5	4	1·5	—	—	—	—	26
19—19·5	—	—	—	—	—	—	—	—	—	·5	·25	·5	1.25	·5	·5	1·5	2·75	·75	2	—	—	·75	·75	12
19·5—20	—	—	—	—	—	—	—	—	—	·5	—	·25	1·25	·5	·25	·25	—	—	—	—	—	·25	·25	3·5
20—20·5	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	·25	·25	—	·5	—	—	—	—	—	1·5
20·5—21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	—	·5	—	—	—	—	—	1
Totals	·5	3	2	7·5	19·5	53·5	90·5	137·5	164·5	192	196·5	177·5	150·5	97	74·5	49·5	27·5	11	6	·5	—	1	1	1463

Mother's Forearm.

	13—13·5	13·5—14	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
Totals	·5	3	2	7·5	19·5	53·5	90·5	137·5	164·5	192	196·5	177·5	150·5	97	74·5	49·5	27·5	11	6	1463

Father's Forearm.

	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
Total	1	1	1	3	5	11	19	30	45	70	79	104	124	139	131	1463

TABLE IX.

Father's Stature and Forearm (Organic).

Father's Stature.

Father's Forearm.	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	Totals
15—15·5	—	—	—	—	—	—	—	—	·75	·25	—	—	—	—	—	—	—	—	1
15·5—16	·5	1·5	—	·5	1·25	·75	—	—	1	·75	·25	—	—	—	—	—	—	—	6·5
16—16·5	—	1	·5	2·5	3	2·25	1	1·5	1·5	3	·5	·75	·5	—	—	—	—	—	18
16·5—17	—	·25	1	1·5	8	9·5	8	10·75	5	2·5	1·25	1	·25	—	—	—	—	—	49
17—17·5	—	·25	1	2·75	8	13	22·5	28·25	26·75	10	8·75	3·5	·75	—	—	—	—	—	125·5
17·5—18	—	·25	·75	·75	6·5	9	22·75	35·5	43·5	33·25	27·25	10	7·25	2·75	·5	—	—	—	200
18—18·5	—	·25	·25	·25	3·25	6	11·75	27·75	37·5	40·25	48·75	32·75	16·25	8	2·5	—	—	—	235·5
18·5—19	—	—	—	·25	1·75	1·25	6	13·25	19·25	29	33·25	34	26·75	13·5	5	·25	—	—	183·5
19—19·5	—	—	—	—	·75	·75	·5	5	8·75	10·5	23	22	23	19	9	3·75	1	—	127
19·5—20	—	—	—	—	—	—	—	1	1·5	2·75	7·5	8·5	14·75	8·25	7·25	2·5	2·25	1·75	58
20—20·5	—	—	—	—	—	—	—	·5	·5	·75	1·5	5·5	8	2·75	6·25	3·5	1·5	1·25	32
20·5—21	—	—	—	—	—	—	—	—	—	1	·5	·5	2	·5	1	2·25	·25	—	8
21—21·5	—	—	—	—	—	—	—	—	—	—	·5	·5	·5	·75	·5	·75	—	—	3·5
21·5—22	—	—	—	—	—	—	—	—	—	—	—	·25	·25	1	·5	—	—	—	2
22—22·5	—	—	—	—	—	—	—	—	—	—	—	·25	1·25	·5	·5	—	—	—	2·5
Total	·5	3·5	3·5	8·5	32·5	42·5	72·5	123·5	146	134	153	119·5	101·5	57	33	13	5	3	1052

TABLE X.

Mother's Stature and Forearm (Organic).

Mother's Stature.

Mother's Forearm.	52—53	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	Totals
13—13·5	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	·5
13·5—14	·5	—	—	—	—	·25	·25	—	—	—	—	·5	—	—	—	—	—	—	—	1·5
14—14·5	·5	—	—	—	·25	1	1·75	·5	·5	1	·75	·25	—	·5	—	—	—	—	—	7
14·5—15	—	—	·25	·25	1·25	2·25	4·25	7·75	6	1·75	1·5	2·25	1	·5	—	·25	·25	—	—	29·5
15—15·5	—	—	·5	1·25	1·75	5·25	8·5	13·75	16·5	11	3·5	4	1·75	·25	—	·25	·25	—	—	68·5
15·5—16	·5	·5	·25	1	2·75	5·75	9·75	22	43·25	38·75	26·75	17·5	4·25	1	—	—	—	—	—	174
16—16·5	—	—	—	—	·5	2·5	5·75	20	37·5	58·5	62·75	40·5	17·25	5	2·25	·75	·25	—	—	253·5
16·5—17	—	—	—	—	—	1	2·5	12	17·5	33·5	54	46·5	37·75	17·75	9·75	2·5	·25	—	—	235
17—17·5	—	—	—	—	—	·5	1	2·75	8·5	14·25	26·5	31	32	26·75	13·25	2·5	1·5	—	—	160·5
17·5—18	—	—	—	—	—	—	·75	1·25	1·5	2·75	5·25	14·75	10·5	16·25	9	5	2	1·5	—	70·5
18—18·5	—	—	—	—	—	—	—	—	·75	1	·5	4·25	7·5	7·25	6·25	3·5	1·5	1·5	1	35
18·5—19	—	—	—	—	—	—	—	·25	·75	·25	·25	·75	2·25	1·75	1	1·25	1	—	·5	10
19—19·5	—	—	—	—	—	—	—	·25	·25	·25	·25	·25	·25	1·5	—	5	·5	·5	·5	5
19·5—20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	·5
Totals	1·5	·5	1	2·5	6·5	18·5	34·5	80·5	133	163	182	163	114·5	78·5	41·5	16·5	7·5	4	2	1051

TABLE XI.

Brother's Stature and Forearm (Organic).

Stature.

Forearm.	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	Totals
14·5—15	·25	·25	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	1
15—15·5	·25	·25	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	1
15·5—16	—	—	—	—	—	·75	2	·5	·75	1	·5	—	—	—	—	—	—	—	—	—	—	5·5
16—16·5	—	·25	·25	1	2	·75	2	1	1·75	1	1	—	—	—	—	—	—	—	—	—	—	11
16·5—17	·25	·5	·75	2·5	5·75	8	6·25	7·5	4	2·5	·75	·5	·25	—	—	—	—	—	—	—	—	39·5
17—17·5	·25	·25	·5	1	11	22	21·5	16·25	14·25	5·75	1	1·25	1	—	—	—	—	—	—	—	—	96
17·5—18	—	—	—	2·5	6·25	15·75	24·5	39·75	37	28·5	11·75	7·25	2·5	·25	—	—	—	—	—	—	—	176
18—18·5	—	—	—	1·5	6·25	5·5	17·25	37·75	59·75	60	32·75	25·75	10	1·5	1·5	·25	·25	—	—	—	—	260
18·5—19	—	—	—	—	·25	2·25	3·25	15·75	36·75	48·75	38·25	44	20·25	9·25	3·5	2	·75	—	—	—	—	225
19—19·5	—	—	—	1	—	·5	·75	5·25	15·25	25·75	29·25	38	28	12·25	6·5	4	·5	—	—	—	—	167
19·5—20	—	—	—	—	—	—	—	1·5	3·5	10·75	16	16	19·75	17·75	12·25	4·5	1·25	·75	·5	—	—	104·5
20—20·5	—	—	—	—	—	—	—	·25	1·5	3·5	3·75	2·25	7·75	7·75	7·75	4·75	1·5	·75	—	—	—	41·5
20·5—21	—	—	—	—	—	—	—	—	—	·75	·75	1·25	·25	2·75	4·5	1	2	1·25	—	·5	—	15
21—21·5	—	—	—	—	—	—	—	—	—	·25	·25	·75	·25	·5	2	1	·25	·75	·5	1	—	7·5
21·5—22	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	·5	·5	·5	3·5
22—22·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
22·5—23	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
23—23·5	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Totals	1	1·5	1·5	9·5	31·5	55·5	77·5	126	175	189·5	136	138	91	52	38	17·5	6·5	3·5	1·5	2	·5	1155

TABLE XII.

Daughter's Stature and Forearm (Organic).

Daughter's Stature.

Daughter's Forearm	52—53	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	Totals
13·5—14	—	—	—	—	—	—	·25	·25	·25	·25	—	·25	·25	—	—	—	—	—	—	—	—	—	1·5
14—14·5	—	—	—	—	·5	·5	·25	1·25	·75	·5	·75	·25	·25	1	—	—	—	—	—	—	—	—	6
14·5—15	—	—	—	1	2	3	2·25	1·75	2·5	2·75	1	2·25	—	—	—	·25	·25	—	—	—	—	—	19
15—15·5	·25	·25	—	—	1·5	5·25	5	13·25	18·25	12·5	8·25	4·25	1·25	·5	·25	·5	·25	—	—	—	—	—	71·5
15·5—16	·25	·25	—	—	1	3·75	5·25	17·75	32·75	44·5	39·25	20	12·75	4·25	2	·25	·75	·25	—	—	—	—	185
16—16·5	—	—	—	—	—	1·75	1·75	13·25	32	54·5	78·75	68	44·75	16·5	7·75	1·5	·75	·25	—	—	—	—	321·5
16·5—17	—	—	—	—	—	·5	·75	4·5	10·5	24·5	47·5	72·5	70·5	47	28·5	10·25	1	—	—	—	—	—	318
17—17·5	—	—	—	—	—	·25	·5	1·5	5	8	22	41	55·75	56·25	42	17	10	1·25	—	—	—	—	260·5
17·5—18	—	—	—	—	—	—	—	—	·5	1·5	4	8·25	19·75	30·75	50	28·5	12·25	4·5	1·5	—	—	—	161·5
18—18·5	—	—	—	—	—	—	—	—	—	·75	1·5	3·5	8·25	11·5	19·75	15	8	6·5	3·75	·5	—	—	79
18·5—19	—	—	—	—	—	—	—	—	—	·25	·5	·25	—	2	4·75	5	3·75	6	2·75	1·25	—	—	26·5
19—19·5	—	—	—	—	—	—	—	—	—	—	—	·25	·75	1·25	1	1	1·75	1·5	2	2	—	·5	12
19·5—20	—	—	—	—	—	—	—	—	—	—	—	·25	·75	—	—	·25	·5	·5	·5	·25	—	·5	3·5
20—20·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	1	·25	—	—	—	—	1·5
20·5—21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·75	—	—	—	—	—	1
Totals	·5	·5	—	1	5	15	16	53·5	102·5	150	203·5	221	215	171	156	80	41	21	10·5	4	—	1	1468

TABLE XIII.

Father's Stature and Mother's Stature.

Father's Stature.

Mother's Stature.	*58—59*	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	*72—73*	*73—74*	*74—75*	*75—76*	Totals
52—53	—	—	—	—	—	—	—	1	·5	—	—	—	—	—	—	—	—	—	1·5
53—54	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	—	—	—	·25	·25	—	·5	—	—	—	—	—	—	—	1
55—56	—	—	—	·5	1	—	—	·25	·25	—	·5	—	—	—	—	—	—	—	2·5
56—57	—	—	—	—	·75	1·25	—	1	1·75	1·75	—	—	—	—	—	—	—	—	6·5
57—58	—	—	—	·25	1	1·25	1·5	4	3·25	2·5	3	1·25	·5	—	—	—	—	—	18·5
58—59	—	·25	·75	1·25	1·25	2·75	4	7	5·75	4·5	3·75	1·25	2	—	—	—	—	—	34·5
59—60	—	1·25	1·25	1	4	4·5	7·75	10	15	16·75	9	5·5	3·25	1·25	1	·5	—	—	82
60—61	·25	·25	·5	2	4·25	4·5	18	16	24	14·75	23·25	12·75	7·25	5·75	4·25	·75	—	—	138·5
61—62	·25	·25	—	—	8	8·25	15	17·25	25	20·75	24	14·25	14·25	10	4	·75	·5	—	162·5
62—63	—	·5	·5	1·25	4·75	7·75	10	26	21·25	28	28	23	14·25	10·75	4·5	2	1	·5	184
63—64	—	—	·25	2	3·5	4·5	9	21	15·75	20·75	19·5	24	22·5	10·75	4	2·25	2·25	·5	162·5
64—65	—	—	1·25	·75	2	6	6·5	9·75	16	18·25	23	16·75	13·75	6·75	4·75	2·25	·25	1·5	129·5
65—66	—	—	—	·25	1·5	1·5	3·25	5·5	9·75	7	15·5	12·75	10·5	6·25	4·25	1·75	·25	—	80
66—67	—	—	—	·25	1	·75	·5	3·5	5	3	7·25	7·75	7	3·5	2·75	1·5	·25	—	44
67—68	—	—	—	—	—	—	—	1	2·5	1·5	2·75	3·25	2·75	1·5	1	·5	·25	—	17
68—69	—	—	—	—	—	—	—	—	—	1	2·5	1·25	1·25	·5	1	·25	·25	—	8
69—70	—	—	—	—	—	—	—	—	—	—	—	·25	2·25	—	2	—	—	—	4·5
70—71	—	—	—	—	—	—	—	—	—	—	—	—	1	—	·5	—	—	—	1·5
Totals	·5	2·5	4·5	9·5	33	43	75·5	123·5	146·5	140·5	162·5	124	102·5	57	34	12·5	5	2·5	1079

TABLE XIV.

Father's Span and Mother's Span.

Mother's Span.

Mother's Span.	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	*72—73*	*73—74*	*74—75*	*75—76*	*76—77*	*77—78*	*78—79*	*79—80*	*80—81*	Totals
52—53	—	—	—	—	·5	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
53—54	—	—	—	—	—	—	·5	·5	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	1·5
54—55	—	—	—	—	—	·5	·5	—	—	—	·25	·25	1·5	—	—	—	—	—	—	—	—	—	3
55—56	—	—	—	—	2·25	1·25	1	1·25	2·75	—	1·5	·5	·5	—	—	—	—	—	—	—	—	—	11
56—57	—	—	·5	2·25	1·5	2·75	1·5	2·25	2·75	4·5	4	1·25	1·75	—	·5	·5	·5	—	—	—	—	—	26·5
57—58	—	—	·5	·25	·75	3	9	4·25	5	8·25	3	·5	2·25	1·25	·5	—	·5	—	—	—	—	—	39
58—59	—	—	1·25	·75	2·5	3	4·5	10·5	7·75	10·25	7·25	4	5·5	2·75	1	·5	—	—	—	—	—	—	61·5
59—60	·5	1·5	·5	1·75	6·5	8	7	16·75	14·75	14·75	15·25	11·75	9	4·25	1·75	1	·5	—	—	—	—	—	115·5
60—61	·75	1·75	·25	1·25	2·75	7·75	9	22·5	19·75	13	14	11·5	12·5	8·5	4·5	3·25	1	—	—	1	—	—	135
61—62	·75	1·75	3	2·5	2·25	12	6·5	14·25	15	22·75	18	13·25	8·25	9·5	7	2·75	2·5	1	—	—	—	—	143
62—63	—	—	1	1	1·5	9·5	10·75	10·75	19·25	17·75	20	17	8	11·25	5·25	4·25	2·75	—	—	—	—	—	140
63—64	—	—	1·25	2·25	2·25	5	8·5	12·25	9	14·5	14·5	12·5	14·5	8·5	5·5	3·75	1·5	2	·75	—	—	·5	119
64—65	—	1	1·5	2·25	1·25	4·25	4·5	7·5	12·5	11·75	9·25	14	5	3·75	2·5	3·5	1·75	1·25	·5	—	—	·5	88·5
65—66	—	·5	·25	·25	3	1	2·25	4·75	5·5	11	7·25	5·75	2·75	3·75	2·5	1	1·5	1·25	·25	—	—	—	54·5
66—67	—	—	—	—	·5	·5	2	·75	2·75	3	4	4·75	1·75	3	1·5	·5	1	·5	—	·5	—	—	27
67—68	—	—	·25	·75	·5	·5	2	·25	2	1·25	1·5	1·25	·25	2·5	·5	·25	·25	·5	—	·5	—	—	15
68—69	—	—	·25	·75	—	—	—	—	1·25	·25	2	1·5	·5	1	1·5	·75	·75	—	—	—	—	—	10·5
69—70	—	—	—	—	—	—	·5	1	1·5	—	1·5	—	·5	1·25	·25	·5	1	—	—	—	—	—	8
70—71	—	—	—	—	—	—	—	—	—	—	·25	·25	1·5	·25	·25	—	1·5	—	—	—	—	—	4
71—72	—	—	—	—	—	—	—	·5	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	1
72—73	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
Totals	2	6·5	10·5	16	28	59·5	70	110·5	121·5	133	124	100·5	76	61·5	35	22·5	17	6·5	1·5	2	—	1	1005

TABLE XV.

Father's Forearm and Mother's Forearm.

Father's Forearm.

Mother's Forearm.	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
13—13·5	—	—	—	—	—	—	—	—	—	—	·25	·25	—	—	—	·5
13·5—14	—	—	—	—	—	—	·25	·25	—	·25	·5	·25	—	—	—	1·5
14—14·5	·5	·5	·5	1	·25	·75	·75	1·25	—	·5	·5	·25	·25	—	—	7
14·5—15	·5	·75	1	1·25	5	8	3·75	3·75	1·75	·5	·25	·25	·25	·25	·25	27·5
15—15·5	—	·25	1	5·25	12·5	16	13·25	8	3·5	·75	1	·25	·25	·25	·25	62·5
15·5—16	—	1·5	5·5	9·5	22·5	35·5	34·25	30·75	14·75	5·25	3·75	·75	·5	—	—	164·5
16—16·5	—	1·25	5·25	11·5	32·75	43·5	58·5	41·25	29·75	11·75	4·75	1·25	1	—	—	242·5
16·5—17	—	1·25	2·25	11·5	23·75	40·75	51	43·5	29·25	13·5	4·75	·75	·25	·25	·25	223
17—17·5	—	·25	1·25	4·25	10·75	24	41·5	27·25	22	8·75	5·75	3	·5	·5	·25	150
17·5—18	—	·25	·75	1·5	7	12	11·5	11·5	11·25	6·75	3·75	1	·5	·5	·25	68·5
18—18·5	—	—	—	·5	3·25	4·5	6·75	5·75	6	4·75	3·5	—	—	·25	·25	35·5
18·5—19	—	—	—	·5	·5	1	1·25	1·5	2·25	2	2	—	—	—	—	11
19—19·5	—	—	—	·25	·25	—	·75	1·25	1·25	1	·75	—	—	—	—	5·5
19·5—20	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	·5
Totals	1	6	17·5	47	118·5	186	223·5	176	122	56	31·5	8	3·5	2	1·5	1000

TABLE XVI.

Father's Stature and Mother's Span.

Father's Stature.

Mother's Span.	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	Totals
52—53	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
53—54	—	—	—	—	—	—	1	—	—	·5	—	—	—	—	—	—	—	—	1·5
54—55	—	—	—	—	·5	—	—	—	·5	·5	1	—	·5	—	—	—	—	—	3
55—56	—	—	—	·5	1·25	·5	2·75	1·5	2	·75	1·75	·5	·5	—	—	—	—	—	12
56—57	—	—	—	1	1·75	2·5	2·25	4·25	4·75	3	4	·5	1	—	—	1	—	·5	26·5
57—58	—	—	—	·5	1	1·75	3·5	8·75	5·5	7·25	6·5	3	·25	·75	1	·25	—	·5	40·5
58—59	—	·25	·25	2·25	2·5	2·5	6·5	4·75	11	13·5	9·5	6·25	2·5	3·5	2	·5	·75	—	68·5
59—60	—	·25	1·25	·25	3·25	8·25	8·75	18·25	20·75	14·5	18·25	12·5	8	4·75	2·5	·5	1	—	123
60—61	·25	·25	1·5	1	4·75	4·75	11·75	18·75	26·75	17	13·5	13·5	11·25	7·5	7·25	1·5	·25	—	141·5
61—62	·25	1·25	·5	·5	2·75	5·75	10·25	19·75	20·25	18·25	23·75	14·5	10·5	11·75	4·25	2·25	·5	·5	147·5
62—63	—	—	—	1·25	6·25	4	6·5	15·5	17·25	23·25	25	19·75	13·75	9·75	2·25	1·5	1	1	148
63—64	—	—	—	·25	3·5	5·5	7	9·75	12·5	10·5	24·75	19·5	14·5	6	5	2	·25	—	121
64—65	—	·5	1·25	·75	2·5	2·75	5·5	11·75	10·5	11·25	9·25	12·25	14	4·5	4·25	1·5	·5	—	93
65—66	—	—	·25	·25	2	2·25	1·25	5	7	9	7·25	8·25	9·5	3·75	1·5	1·5	·5	·25	59·5
66—67	—	—	—	—	—	·5	1·75	1·25	3	3·5	4·5	4	4·25	2·5	·75	—	·25	·25	26·5
67—68	—	—	—	—	·5	1	1	1	1·75	2·75	1·5	2	3·75	·5	·75	—	—	—	16·5
68—69	—	—	—	—	—	·5	·75	·25	—	·5	1·5	1·5	3	1	2·5	—	—	—	11·5
69—70	—	—	—	—	—	—	1·5	1·5	1·5	—	2	·5	2	·5	—	—	—	—	9·5
70—71	—	—	—	—	—	—	—	—	·25	·25	·5	—	1·75	·75	·5	—	—	—	4
71—72	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	·5
Totals	·5	2·5	5	8·5	32·5	42·5	72	123	145·5	136·5	154·5	118·5	101	57·5	34·5	12·5	5	3	1055

TABLE XVII.

Father's Stature and Mother's Forearm.

Father's Stature.

Mother's Forearm.

	28—29	29—30	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	Totals
13—13·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	—	·5
13·5—14	—	—	—	—	—	—	—	·5	—	·5	—	—	—	—	—	·25	·25	—	1·5
14—14·5	—	—	—	·5	·25	·75	—	·5	1·5	1·5	—	—	·25	·25	·5	·5	—	—	7
14·5—15	—	—	—	·5	1·25	1·75	1	3·5	6	4	4·75	1·5	2	1·25	1	—	—	—	29
15—15·5	—	—	—	1·75	3	2·75	6·25	11·5	14·75	8·25	7·25	2·5	3·75	3·25	2	—	—	·5	67·5
15·5—16	—	·5	·5	1·75	7	9·5	16·5	23·5	25·25	24·25	22·5	19	10·5	9·25	3·75	1·25	·5	·5	176
16—16·5	—	·5	·5	2	7	10·75	22·25	30	32·75	35·75	35·25	33·5	16·5	13·25	5·5	1·5	1·5	1·5	250
16·5—17	·5	1·25	1·75	2	6·5	8·5	10·75	28	31·25	32·75	37·75	25	26·25	11·75	5·75	4·25	1·5	—	235·5
17—17·5	—	·25	·25	1·25	4·25	4·5	7	12·25	20	20·5	28·75	20·25	24·25	8·5	5	3·75	·25	·5	161·5
17·5—18	—	—	—	·25	1·75	1·25	4·25	7·75	9·25	6·75	8	9	10	6	3·5	1	·75	—	69·5
18—18·5	—	—	—	—	·5	1·5	2·25	3·25	4·75	2·5	5·5	5·25	2·75	2·75	3·25	·75	—	—	35
18·5—19	—	—	·25	·25	·5	·75	·25	·25	·5	·25	2·75	1·5	1·75	·25	·75	—	—	—	10
19—19·5	—	—	·25	·25	·5	—	—	—	—	—	1·5	·75	2·25	—	—	—	—	—	5·5
19·5—20	—	—	—	—	—	—	—	—	—	—	—	·25	1·25	—	—	—	—	—	1·5
Totals	·5	2·5	3·5	10·5	32·5	42	71	121	146	137	154	118·5	101·5	56·5	31	14	5	3	1050

TABLE XVIII.

Father's Span and Mother's Stature.

Father's Span.

Mother's Stature.	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	Totals
52—53	—	—	—	—	·5	·5	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	1·5
53—54	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	—	—	—	—	·75	·25	—	—	—	—	—	—	—	—	—	—	—	—	1
55—56	—	—	—	—	—	·75	·75	—	·75	·25	—	—	—	—	—	—	—	—	—	—	—	—	2·5
56—57	—	—	—	—	·25	1·5	·5	1·5	1·75	1	—	—	—	—	—	—	—	—	—	—	—	—	6·5
57—58	—	—	—	—	1·25	3·25	1·5	2·25	1·25	2	·75	·2	3·25	—	—	—	—	—	—	—	—	—	17·5
58—59	—	·5	—	1·25	3·25	1·75	5·5	5·25	3·5	4	3·75	3·5	2	·25	—	—	—	—	—	—	—	—	34·5
59—60	·25	1·5	2·25	1·75	2·75	6·25	8·25	10	10·75	12·25	11	4·75	4·25	2	·75	1·5	·25	—	—	—	—	—	80·5
60—61	·5	·75	2·25	1	3·5	11·5	9·75	13·5	21·25	22·25	11·75	11	9·5	7·5	3·5	1·75	·75	·5	—	1	—	—	133·5
61—62	·25	1·25	·5	2·25	5	11·25	9	23·75	18·75	21·75	20·25	16·75	12·25	9·25	5·75	3·25	1·25	·5	—	—	—	—	163
62—63	—	·5	2·5	4	3·25	8·5	12	24·5	25	16	25·5	18	12·5	11·25	11·25	2·5	3·25	1·75	·75	—	—	—	183
63—64	·25	1·25	1	1	3·25	10·25	9·25	11·5	19·5	21	21·75	21	11·5	16	6	5	1·5	·5	·5	1	—	—	163
64—65	·75	·75	1	2·25	2	5·75	6·5	8·5	12·75	17·5	13·75	15·75	10·75	9	2·5	1·25	3·25	·25	·25	—	—	—	114·5
65—66	—	—	·75	1·75	2	1·25	4·25	7·25	6·75	7·5	8·75	11	11·25	4·75	2·75	4·75	2	1·25	—	—	—	1	79
66—67	—	—	·25	·5	·25	—	3·75	6	3·75	7·75	4·25	3·75	·75	3·25	1·75	2	2·75	1·75	—	—	—	—	42·5
67—68	—	—	—	·75	·75	·5	1·5	1	2·5	2	4	·25	·25	1	1·25	·25	—	—	—	—	—	—	16
68—69	—	—	—	—	—	—	1	—	·5	·5	1·5	·25	·25	1·25	2	·25	—	—	—	—	—	—	7·5
69—70	—	—	—	—	—	—	—	—	—	—	—	1	1·5	1·5	·5	—	—	—	—	—	—	—	4·5
70—71	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	2
Totals	2	6·5	10·5	16·5	28	63	73·5	115	129·5	137	127	109	80	67	38	22·5	17	6·5	1·5	2	—	1	1053

TABLE XIX.

Father's Span and Mother's Forearm.

Father's Span.

Mother's Forearm.	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	Totals
13—13·5	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	·5
13·5—14	—	—	—	—	·25	·25	—	—	—	·5	·25	·25	—	—	—	—	—	—	—	—	—	—	1·5
14—14·5	—	—	—	·5	·25	·75	1	1·5	—	·5	·25	·25	·5	·5	·25	·75	—	—	—	—	—	—	7
14·5—15	·25	·25	—	·5	·75	1·5	3	5·5	5·75	3·25	1·5	1·75	2·75	1	1	·75	—	—	—	—	—	—	29·5
15—15·5	·25	1·25	1·75	1	2·25	5·25	7	10	10	7·5	6·25	4·5	6	2	1·5	·25	·75	—	—	—	—	—	67·5
15·5—16	—	1·25	1·75	2·75	6·5	14·5	13	22·75	21·75	24·5	17·5	16	14·75	8	4·5	2·5	1	·25	·25	·5	—	—	174
16—16·5	—	1·25	1·75	3·5	6·75	19·5	17·75	27·5	34·25	34	35	24	15·75	13	9·25	6·25	2·5	·25	·25	·5	—	·5	253·5
16·5—17	1·5	3	3	3·5	4·25	12	14·5	19·5	25·75	30·5	30·25	32	17	16·5	8·25	5·25	5·25	2·5	—	—	—	·5	235
17—17·5	—	—	·5	1·25	3·75	6	9	18	17·25	24·25	20	18·25	13·75	13·5	5·75	2·75	3·5	2·25	·75	·5	—	—	161
17·5—18	—	—	·25	1·25	1·75	2·5	5·75	5·5	8·75	7·5	10·25	7·75	5·25	4·75	4	1·5	1·25	1·25	·25	·5	—	—	70
18—18·5	—	—	·25	1	1·5	·75	2	2·75	4·75	3·75	2·75	3·75	2·25	5·5	2·75	1·5	1·25	—	—	—	—	—	36·5
18·5—19	—	—	·75	·75	—	—	—	·5	1·25	1·25	1·75	·25	—	2·25	1·25	·75	·75	—	—	—	—	—	11·5
19—19·5	—	—	·5	·5	—	—	—	—	—	—	1·25	·25	1·5	—	—	·25	·75	—	—	—	—	—	5
19·5—20	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	·5
Totals	2	7	10·5	16·5	28	63	73	113·5	129·5	138	127	109	80	67	38·5	22·5	17	6·5	1·5	2	—	1	1053

TABLE XX.

Father's Forearm and Mother's Stature.

Father's Forearm.

Mother's Stature.	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
52—53	—	—	—	—	—	·5	·5	·5	—	—	—	—	—	—	—	1·5
53—54	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	·25	·25	·25	·25	—	—	—	—	—	—	—	1
55—56	—	—	—	·5	·75	·75	·25	·25	—	—	—	—	—	—	—	2·5
56—57	—	—	—	1·25	·5	2·5	2	·25	—	—	—	—	—	—	—	6·5
57—58	—	—	—	·25	4	5	3·75	2·5	1·5	·25	·25	—	—	—	—	17·5
58—59	·5	1·25	2	1·5	3·5	9	8·75	5·25	2·75	·25	·25	·25	·25	—	—	35·5
59—60	—	1·25	3·75	7·5	11·5	17·5	15·75	11·5	6·75	·75	1·5	·75	·5	—	—	79
60—61	—	·5	1·75	5·25	18·75	29·25	30·75	23·25	11·75	6·75	2·75	1	·75	—	—	133
61—62	—	1·25	2	7·75	25·75	26·75	34·75	34	19·5	7·5	2·75	—	—	—	—	162
62—63	—	1	3	9·25	21·75	34·5	40·75	31·25	22	12	4·75	1·25	1	—	—	182·5
63—64	·25	·75	1·75	4·25	15·75	26·75	39	29	26·5	9·25	6·5	1·25	·5	1·25	1·25	164
64—65	·25	·5	2·5	6·5	7·75	18·75	28·25	23·25	13·5	6·75	4·5	1·5	—	·25	·75	115
65—66	—	·25	1·5	1·5	8·25	13·5	16	13·5	9·5	8·75	3·75	1	·5	·5	·5	79
66—67	—	·25	·25	·75	3·75	7·75	9	7·25	7·25	2·25	2	1	—	—	—	41·5
67—68	—	—	—	1	2	4	3·5	1·25	2·5	1·25	·5	—	—	—	—	16
68—69	—	—	—	1·25	·25	·75	1	1	2	·75	·5	—	—	—	—	7·5
69—70	—	—	—	—	—	—	·75	·75	1·5	1	·5	—	—	—	—	4·5
70—71	—	—	—	—	—	—	—	—	—	·5	1·5	—	—	—	—	2
Totals	1	7	18·5	48·5	124·5	198	235	185	127·5	58	32	8	3·5	2	2·5	1051

TABLE XXI.

Father's Forearm and Mother's Span.

Father's Forearm.

Mother's Span.	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
52—53	—	—	—	—	—	—	·5	·5	—	—	—	—	—	—	—	1
53—54	—	—	—	—	·5	·5	—	—	—	·25	·25	—	—	—	—	1·5
54—55	—	—	—	—	·25	·75	—	·25	1·25	·25	·25	—	—	—	—	3
55—56	—	—	—	·75	3·25	4·75	2	·5	·75	—	—	—	—	—	—	12
56—57	—	—	1·25	1·25	5·75	7·25	5·25	2·5	·75	—	·5	·5	·5	—	—	25·5
57—58	—	—	·75	3	4·75	9·5	10	7·5	2·5	1	1	—	—	—	—	40
58—59	·25	·25	2	4·75	7·25	13·75	17·75	13	5·5	1·75	1	·25	—	—	—	67·5
59—60	·25	·75	2·5	6·5	15·5	27·5	28	23·75	11·75	4·25	1·75	·5	—	—	—	123
60—61	—	1	3·75	6·75	21·5	27·5	25	25	16·5	7·25	5·5	·75	·5	—	—	141
61—62	·25	2·25	3·75	7·75	17	23	33·25	26·25	19·25	9	3·25	1·25	·75	·5	·5	148
62—63	·25	1·25	1·5	3·5	17·5	23·75	34·75	28	23·25	9·25	2	·75	·75	·25	1·25	148
63—64	—	·5	1·5	6·25	10	20·25	27·75	23·25	19·25	6·5	2·75	·75	·75	1	·5	121
64—65	—	1	1·5	2·5	11·5	16·5	21·5	16·25	11·75	5·5	3·5	1·25	·25	·25	·25	93·5
65—66	—	—	—	2·5	5·25	13·5	15·25	8·25	6·5	3·5	3·25	1·5	—	—	—	59·5
66—67	—	—	—	·5	·5	4·5	9	5·5	2	3	1·5	—	—	—	—	26·5
67—68	—	—	—	1·75	1·25	3·25	2·25	1·5	2	2·25	2	·25	—	—	—	16·5
68—69	—	—	—	·75	·75	·75	1·25	1	2·75	2	1·5	·25	—	—	—	11
69—70	—	—	—	—	1·5	1·75	1	1·25	·75	1	·75	—	—	—	—	8
70—71	—	—	—	—	—	·5	·75	·25	·5	·75	1·25	—	—	—	—	4
71—72	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	·5
Totals	1	7	18·5	48·5	124	199·5	235·5	184·5	127	57·5	32	8	3·5	2	2·5	1051

TABLE XXII.

Father's Stature and Son's Stature.

Father's Stature.

Son's Stature.	58·5—59·5	59·5—60·5	60·5—61·5	61·5—62·5	62·5—63·5	63·5—64·5	64·5—65·5	65·5—66·5	66·5—67·5	67·5—68·5	68·5—69·5	69·5—70·5	70·5—71·5	71·5—72·5	72·5—73·5	73·5—74·5	74·5—75·5	Totals
59·5—60·5	—	—	—	—	·5	·5	1	—	—	—	—	—	—	—	—	—	—	2
60·5—61·5	—	—	—	—	·5	—	—	—	1	—	—	—	—	—	—	—	—	1·5
61·5—62·5	—	·25	·25	—	·5	1	·25	·25	·5	·5	—	—	—	—	—	—	—	3·5
62·5—63·5	—	·25	·25	2·25	2·25	2	4	5	2·75	1·25	—	·25	.25	—	—	—	—	20·5
63·5—64·5	1	—	1·5	3·75	3	4·25	8	9·25	3	1·25	1·5	·75	1·25	—	—	—	—	38·5
64·5—65·5	2	·1	·5	2	3·25	9·5	13·5	10·75	7·5	5·5	3·5	2·5	—	—	—	—	—	61·5
65·5—66·5	—	·5	1	2·25	5·25	9·5	10	16·75	17·5	16	5·25	2	2·5	1	—	—	—	89·5
66·5—67·5	—	1·5	2	4.75	3·5	13·75	19·75	26·5	25·75	19·5	12·5	13·75	3·25	·5	1	—	—	148·0
67·5—68·5	—	—	1·5	2	7·5	10	10·25	24·25	31·5	23·5	29·5	13·25	8·5	9·5	2·25	—	—	173·5
68·5—69·5	—	—	1	—	5·25	5	12·75	18·25	16	24	29	21·5	10	3·5	2·25	—	1	149·5
69·5—70·5	—	—	—	—	1	2·5	5·75	18·75	11·75	19·5	22·5	19·5	14·5	6·25	3·5	1·5	1	128·0
70·5—71·5	—	—	—	—	—	3·25	5	8·75	10·75	19	14·75	20·75	10·75	8	5	1	1	108·0
71·5—72·5	—	—	—	—	—	·25	3	1.25	7	7·75	10·75	11·25	10	8·5	2·75	·5	—	63·0
72·5—73·5	—	—	—	—	—	—	·75	·75	2·5	7·5	6·5	6	7·5	6·25	3·25	·5	·5	42·0
73·5—74·5	—	—	—	—	1	—	1·5	1·5	—	5·25	2·25	2·5	6·5	3·25	3·25	—	2	29·0
74·5—75·5	—	—	—	—	—	—	—	—	—	1	2	—	2·5	·75	1·75	·5	—	8·5
75·5—76·5	—	—	—	—	—	—	—	—	—	1·25	·25	—	·5	1	1	—	—	4·0
76·5—77·5	—	—	—	—	—	—	—	—	—	1·25	·25	1	—	—	1·5	—	—	4·0
77·5—78·5	—	—	—	—	—	—	—	—	—	—	1	1	—	·25	·75	—	—	3·0
78·5—79·5	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	—	—	·5
Totals	3	3·5	8	17	33·5	61·5	95·5	142	137·5	154	141·5	116	78	49	28·5	4	5·5	1078

TABLE XXIII.

Father's Span and Son's Span.

Father's Span.

Son's Span.	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	Totals
58—59	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
59—60	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
60—61	·25	·25	—	—	—	—	—	1	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	2
61—62	·25	·25	—	—	—	—	1	—	—	·5	·5	—	—	—	·5	—	—	—	—	—	—	—	3
62—63	—	—	—	—	·25	1·25	·5	·5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	3·5
63—64	—	—	—	1	1·75	2·25	2·5	1·5	·75	1·5	·25	·5	·5	—	—	—	—	—	—	—	—	—	12·5
64—65	—	1	·25	·25	2	3·25	3·5	3·25	6·5	3·75	·75	1	·75	·75	—	—	—	—	—	—	—	—	27
65—66	·25	·75	3·25	3·25	3·25	9·75	5	9·5	7·25	5·5	5·5	3	1·75	2	—	—	—	—	—	—	—	—	60
66—67	·25	1·25	2·5	4·5	3·75	11	10·5	13·25	7·25	9·75	4·75	5·75	1·25	1·5	·25	—	·5	—	—	—	—	—	78
67—68	—	1·25	2	·75	3·5	11·25	9·5	14·75	16·25	13·5	9·5	5·25	5·75	4·5	1·5	·5	·75	—	—	—	—	—	100·5
68—69	—	1·25	1·75	·75	2·25	10·75	6·75	15	17·75	21·5	15·25	12	9·25	4·25	2·75	1·5	·75	—	—	—	—	—	123·5
69—70	·5	1	·75	1·5	2·25	6·25	11·75	20·5	18·75	19·75	19·5	16	8	5	1·5	1	·5	1	—	1	—	—	136·5
70—71	—	—	1	1	1·75	7·5	10·25	13	17·25	20·5	22	19·25	12	6·5	6·5	—	1·5	—	—	·5	—	—	140·5
71—72	—	—	·25	·25	·25	3·75	6·5	8	13	13·5	17	15·25	14·25	9	5	2	1·5	1	—	·5	—	—	111
72—73	—	—	·25	1·75	1	2·5	3·75	6·75	8·5	12·25	10·5	11	12	8	6·75	5·5	1	·75	·25	—	—	—	92·5
73—74	—	—	—	·75	1·25	·5	3·5	3	6·5	9·75	8·5	8·25	9·75	8·5	7·75	3·5	1·5	1·75	·25	—	—	—	75
74—75	—	—	—	2·25	·25	·5	·5	1	4·25	3·25	5·75	4·5	3	4·25	7·25	4·75	2·5	5	—	—	—	—	44·5
75—76	—	—	—	—	—	1·5	—	·5	1	·5	4·5	3	2·5	4	2·5	1·5	3	1·5	—	·5	—	—	26·5
76—77	—	—	—	—	—	—	—	·5	—	1·25	1	1·75	1·75	1	·5	·75	1	—	—	·5	—	—	10
77—78	—	—	—	—	—	—	—	—	—	1·25	·25	—	2·5	1·5	·5	1·5	—	—	—	—	—	—	7·5
78—79	—	—	—	—	—	—	—	—	1	—	·5	·5	1·5	1·25	·25	—	1	—	—	—	—	—	6
79—80	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	·25	·25	—	—	—	·5	2
80—81	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	·25	·25	—	—	—	·5	2
Totals	1·5	7	12	18·5	24	72	75·5	112	127	138	128	107	86·5	62	44	22·5	16	7	0·5	3	—	1	1065

Daughter's Stature.

Totals	52—53	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
27	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
78	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
100·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
123·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
136·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
140·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
111	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
92·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
75	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
44·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
26·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Son's Forearm.

TABLE XXIV.

Father's Forearm and Son's Forearm.

Father's Forearm.

Son's Forearm.	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
14—14·5	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
14·5—15	·5	·5	·25	·5	·25	—	—	—	—	—	—	—	—	—	—	2
15—15·5	—	—	·25	·75	·5	—	—	—	—	—	—	—	—	—	—	1·5
15·5—16	·5	·5	—	·5	2·25	1	·25	·5	·5	—	—	—	—	—	—	6
16—16·5	—	·25	1·25	·75	1·75	2·5	1	·5	·5	·25	·25	—	—	—	—	9
16·5—17	·5	1·75	1·5	2·75	9·25	10·75	5·75	2·5	1·25	·5	·5	—	—	—	—	37
17—17·5	—	1	6·25	12·75	17	22·5	15·25	6·75	1·75	1·25	·5	—	—	—	—	85
17·5—18	·25	2·25	5	13·25	25·75	40·25	35	23·75	11	5·75	·75	·25	·25	—	—	163·5
18—18·5	·25	1·25	4·75	9·25	32·75	50·5	54·5	40·25	27	10·25	3	2	1·75	—	—	237·5
18·5—19	—	1	2·75	5	17·25	37	52·75	43·5	29·25	8·25	4·5	2	·75	·25	·25	204·5
19—19·5	—	1	2	2·75	9·25	22·75	35·75	34·5	31·25	11·75	4·5	1·25	·25	·25	·25	157·5
19·5—20	—	—	—	1	3·25	11·5	18·25	14·25	21	14·75	8	2	·25	·75	·5	95·5
20—20·5	—	—	—	·25	1·25	2·5	6	7·5	7	6·25	4·25	1·75	·5	·75	·5	38·5
20·5—21	—	—	—	—	·75	·75	1·25	2	3·75	2	1·5	·25	·25	·5	·5	13·5
21—21·5	—	—	—	—	·25	·75	1·75	1·25	1·25	1·5	·25	—	—	—	—	7
21·5—22	—	—	—	—	—	·25	1	1·75	—	1	—	—	—	—	—	4
22—22·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Totals	2	9·5	24	49·5	121·5	203	229·5	179	135·5	63·5	28	9·5	4	2·5	2	1063

TABLE XXV.

Father's Stature and Daughter's Stature.

Father's Stature.

Daughter's Stature.	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	Totals
52—53	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	·5
53—54	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
55—56	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
56—57	·25	·25	—	·25	1·25	·5	—	1	·5	·5	—	—	—	—	—	—	—	—	4·5
57—58	·25	·25	·5	1·5	4·5	1	1·5	1·5	2·5	—	·5	·5	—	—	—	—	—	—	14·5
58—59	·25	·75	·5	·75	·75	1	1·75	1·25	5	2·75	·5	·25	—	—	—	—	—	—	15·5
59—60	·5	1	2	—	6	4·75	5	6·25	11·75	3·5	3·5	2	1·75	·5	—	—	—	—	48·5
60—61	·75	·75	—	2·5	8	6·25	12·5	18·25	20·25	11	9	4·75	2·5	1·25	1·25	—	—	—	99
61—62	—	·5	1·75	2	9·75	11·5	13	23·75	23·75	20·25	16·5	10·25	4·25	3	1·25	—	—	—	141·5
62—63	—	1	2·25	2	4·5	12	22·75	26	33	28·25	24·75	14·25	13·75	4·75	·75	·5	—	—	190·5
63—64	—	—	·25	2	6	8·25	11	27·25	35·75	37·25	31·5	26·25	16·25	7·75	1·5	·75	·25	—	212
64—65	—	—	·25	2·5	1·75	3·25	9·25	23	18·75	28·5	33	34·25	24·5	11·75	5·5	1	·25	1	198·5
65—66	—	—	—	·5	1	·5	11	12·25	9·25	19·75	30	26·5	22·25	15	4·75	3·75	2	1	159·5
66—67	—	—	—	·5	·5	1·5	3·25	7·25	8·75	16	26·25	26·75	20·5	18·5	7·75	4·25	·25	·5	142·5
67—68	—	—	—	—	—	—	1	5·75	7	4	14·25	13·25	12	11·25	4·5	3·75	·75	—	77·5
68—69	—	—	—	—	·25	·25	·25	·25	1·5	3	5·5	4·25	5·75	5·25	3·75	2·5	1·5	2	36
69—70	—	—	—	—	·25	·25	·25	·25	·25	·25	1	2·5	6·5	2·25	2·75	2	1	—	19·5
70—71	—	—	—	—	—	—	—	—	—	—	1·75	·25	4·5	·75	1·25	·75	·25	—	9·5
71—72	—	—	—	—	—	—	—	—	—	—	·5	—	·5	·5	1·5	·75	·25	—	4
72—73	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
Totals	2	4·5	7·5	14·5	45	51·5	92·5	155	178	175	199·5	166	135	82·5	36·5	20	6·5	4·5	1376

TABLE XXVI.

Father's Span and Daughter's Span.

Father's Span.

Daughter's Span.	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	Totals
53—54	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	·25	·5	·25	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
55—56	—	—	·25	·75	·5	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
56—57	—	—	·75	·25	—	1	·5	2·5	·5	—	—	·5	·5	—	—	—	—	—	—	—	—	—	6·5
57—58	—	—	·75	·25	·25	·5	3·75	4·5	4	2·5	·5	—	—	—	—	—	—	—	—	—	—	—	17
58—59	·25	·75	—	2·25	4	5·25	9·5	10·5	7·5	6·25	3	·75	1	1·5	—	—	—	—	—	—	—	—	52·5
59—60	·75	1·75	·75	2·75	4·25	9	8·75	10·5	16·5	13·75	7·75	3·5	3	1·75	1·25	—	—	—	—	—	—	—	86
60—61	·75	2·25	2·25	2·5	4·25	15·75	19	18·25	17	14·75	11	10	5·5	4	1·75	1	—	—	—	—	—	—	130
61—62	·25	1·25	3·5	4·25	6·5	15	16·75	16·25	24·75	17·5	20·75	13	5	7·5	3·25	·5	·5	—	—	—	—	—	156·5
62—63	—	·5	1	3·25	7·25	11·75	11·75	18·5	23	23·75	20·5	23·5	14·5	8	7·25	2·75	1·25	1	1	—	—	—	180·5
63—64	·25	1·25	1·5	1	3·25	6	9·5	21·25	23·75	25·5	31	21·75	14·75	11	5·75	1·5	2	·5	—	—	—	—	181·5
64—65	·25	·25	1·25	·25	1·75	9	6	15·25	15·75	28·5	25·75	18	16·25	13·75	8·5	3·75	2·75	1	—	—	—	—	168
65—66	—	—	·25	1·25	—	3·25	4	6·75	13·75	20	27·25	22	14·75	9·5	6	6·25	5	1·75	·75	—	1	—	143·5
66—67	—	—	—	—	2	2	5·5	6·5	7·75	11·25	13·5	12·75	8·5	4·75	8·25	4·25	2	1·75	·25	—	·5	—	91·5
67—68	—	—	—	—	·5	1	1·5	1·25	4·5	9·75	5	12·5	13·5	6	5·5	4·25	1·75	1	—	·5	·5	·5	69·5
68—69	—	—	·25	·25	·5	·25	·75	·5	1·75	3·5	2·5	4·5	4·25	10·75	1·25	3	4·5	1·5	—	·5	—	·5	41
69—70	—	—	·25	·25	—	·25	·25	1	·5	2	1·75	1	3	5·5	1·75	2·75	2·75	·75	·25	—	—	—	24
70—71	—	—	—	—	—	—	—	—	·5	·5	1·75	·25	2·5	1	1	1	—	·25	·25	—	—	—	9
71—72	—	—	—	—	—	—	—	—	—	—	1·5	1	—	1	—	—	1	1·5	—	—	—	—	6
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	·5
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
74—75	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	·5	—	—	—	—	—	1
75—76	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	·5	—	—	—	—	—	1
Totals	2·5	8	13	20	35·5	81	97·5	134	161·5	179·5	173·5	145	108	86	51·5	31	25	11	2·5	1	2	1	1370

Son's Stature.

| Totals | 59—60 | 60—61 | 61—62 | 62—63 | 63—64 | 64—65 | 65—66 | 66—67 | 67—68 | 68—69 | 69—70 | 70—71 | 71—72 | 72—73 | 73—74 | 74—75 | 75—76 | 76—77 | 77—78 | 78—79 |

TABLE XXVII.

Father's Forearm and Daughter's Forearm.

Father's Forearm.

Daughter's Forearm.	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
13·5—14	—	—	·25	·25	·5	—	—	.25	·25	—	—	—	—	—	—	1·5
14—14·5	·5	·75	·75	·5	1	—	1	·25	·25	—	—	—	—	—	—	5
14·5—15	—	·25	2	5·25	3	2·5	3	1·25	·25	—	·25	·25	—	—	—	18
15—15·5	—	·75	4·75	9·5	10·5	14·25	18·25	6·75	1·25	—	·25	·25	—	—	—	66·5
15·5—16	—	2·5	5·5	15·75	31·5	43·5	36·25	19	13·5	3	1	·25	·25	·25	·25	172·5
16—16·5	—	1·25	5·25	14·75	46·5	66	81·5	45	25·25	6·25	3	1·75	1·5	·5	·5	299
16·5—17	—	1·75	2·25	8	34	59·5	75·75	58·75	34·5	14·25	6	2·25	1·25	·5	·25	299
17—17·5	—	·25	·75	4·25	22	34·25	58·75	55	37·75	17	9·75	3·5	1·5	·25	—	245
17·5—18	—	·25	·25	2·5	7·5	14·25	28·5	33	31·75	21·25	8	1·75	1	·25	·25	150·5
18—18·5	—	·25	·25	·75	1·5	4·25	12·25	16	17·75	12	6·25	2·25	·5	·25	·75	75
18·5—19	—	—	—	—	—	·75	2·75	5·25	5·75	4·75	3·25	·5	—	—	·5	23·5
19—19·5	—	—	—	—	·25	·5	·75	1·5	2·5	1·5	2	·5	—	·25	·25	10
19·5—20	—	—	—	—	·25	·25	·25	·5	·5	·25	·25	·25	—	·25	·25	3
20—20·5	—	—	—	—	—	—	—	—	·5	·5	—	—	—	—	—	1
20·5—21	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	·5
Totals	·5	8	22	61·5	158·5	240	319	242·5	172	81	40	13·5	6	2·5	3	1370

TABLE XXVIII.

Mother's Stature and Son's Stature.

Mother's Stature.

Son's Stature.	52—53	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	Totals
59—60	—	—	—	—	—	—	—	·25	·25	·25	·25	—	—	—	—	—	—	—	—	1
60—61	—	—	—	—	—	—	—	·75	·25	·25	·25	—	—	—	—	—	—	—	—	1·5
61—62	—	—	—	—	—	—	1	·5	—	—	—	—	—	—	—	—	—	—	—	1·5
62—63	—	—	—	—	—	—	—	3·5	1·5	2	·5	—	—	—	·5	—	—	—	—	8
63—64	·5	·5	—	—	·25	1·25	2·5	6·75	9	5	3·75	—	—	·5	—	—	—	—	—	30
64—65	—	—	·25	·25	1	3·25	5·75	13	7·75	7	6·75	1·25	1·75	—	1	—	—	—	—	49
65—66	—	—	·5	1	3·75	5·5	4·5	9	14·25	18·25	7·25	6·75	1·75	—	1·25	·25	—	—	—	74
66—67	—	—	·25	·75	1·75	2·75	8·5	15	19·5	20	22·25	10	7·75	2	2·75	·75	·5	—	—	114·5
67—68	—	—	—	—	·25	4·25	5	11·25	27·25	31	36	27	12·75	4	2·25	1·5	·5	—	—	163
68—69	—	—	—	—	—	—	6·75	12·25	27·5	27·25	31·5	26·75	23·25	12·75	5	1·75	·75	—	—	175·5
69—70	—	—	—	—	—	2	—	6	15·25	17	23·25	20·5	20	13·25	4·5	1	·75	·5	—	124
70—71	—	—	—	—	—	1	·5	2·75	9·5	22	21·5	23·5	15·75	14·25	7·5	2·75	·5	·5	—	122
71—72	—	—	—	—	—	—	·5	1	2·75	10·25	13·5	16	13·25	12·75	6	1	1	—	—	78
72—73	—	—	—	—	—	—	·5	1	5	4·25	6	11	7·5	4	4·75	2·5	1	—	—	47·5
73—74	—	—	—	—	—	—	—	—	1·25	4	6·75	6·25	3·75	7	1·5	1·75	1·25	1·5	1	36
74—75	—	—	—	—	—	—	—	—	—	2·5	2·5	2·5	1	3	2	·75	1·25	1·5	—	17
75—76	—	—	—	—	—	—	—	—	—	·5	—	·5	—	1	1·5	1	1·5	—	·5	6·5
76—77	—	—	—	—	—	—	—	—	—	—	—	1	—	1	·75	·25	—	—	·5	3·5
77—78	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	·25	·75	—	—	—	1·5
78—79	—	—	—	—	—	—	—	—	—	·5	—	—	—	·5	·5	·5	—	—	—	2
79—80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
Totals	·5	·5	1	2	7	20	35·5	83	141	172·5	182	153	108·5	76·5	41·5	17·5	9	4	2	1057

TABLE XXIX.

Mother's Span and Son's Span.

Mother's Span.

Son's Span.

	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	Totals
58—59	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	·5
59—60	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	·5
60—61	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	·5
61—62	—	—	—	—	·25	·75	1	1	—	—	—	—	—	—	—	—	—	—	3
62—63	1	—	—	—	·25	·25	1·25	·25	1	—	—	—	—	—	—	—	—	—	4
63—64	—	·25	1·25	·5	3·25	2·25	2·25	2·25	—	·5	·5	—	—	—	—	—	—	—	13
64—65	·25	·5	·25	2·5	4·75	2·5	5·75	2·5	1·75	3·25	·5	2	1	—	—	—	—	—	27·5
65—66	·25	·25	2·5	3·75	5·75	10·5	8·75	8	10·25	5·75	1·5	2·25	·5	—	—	—	—	—	60
66—67	—	—	2	8	7·25	8·75	13·25	10	7·75	9·25	5·5	5	2·75	·25	1·25	—	—	—	81
67—68	—	·25	4	4·5	4·5	11·25	18	14·25	18·75	8·75	9·25	4·75	·25	1·75	1	·5	·25	—	102
68—69	—	·25	1·75	3·75	4	11	13·25	17·25	20	18·25	19	9·5	3·5	1·25	·5	·5	·25	—	124
69—70	—	·25	1	2·25	6·5	8	20	23·25	21	22·75	14·25	9	4·75	2	1	1	·5	—	137·5
70—71	—	1·25	1·25	2·25	3	7·25	15·25	16·5	23	26·5	16·5	15·5	7·25	2·25	2·75	1·5	—	—	142
71—72	—	—	—	1	·5	8·25	6·75	12·25	19	15·75	13·25	12·5	6·75	5·25	2·25	4·5	1·25	·25	109·5
72—73	—	—	—	·5	·5	2·5	4·25	11	17	18·25	11·5	7·75	8·75	6	1·5	1	·25	·25	91
73—74	—	—	—	·5	—	2·5	2·75	6	11·75	8·75	13	5·5	9·5	8·5	4·75	—	1·5	—	75
74—75	—	—	—	—	·25	2·75	1·25	3·25	5·5	5·25	8·75	5·25	4·75	1·5	1	—	2·5	—	42
75—76	—	—	—	·5	·25	·5	·25	2·25	1·75	2·25	4·75	3·5	2·25	1·5	1·75	3·5	1·5	1	27·5
76—77	—	—	—	·5	—	—	—	·5	1·25	1·5	·75	1·5	1·5	·75	·75	·5	—	—	9·5
77—78	—	—	—	—	—	—	—	—	1·25	·75	1·5	1	1·25	·25	—	—	·75	·75	7·5
78—79	—	—	—	—	—	1	—	—	—	—	1·75	·25	·25	·5	1·25	—	·75	1·75	7·5
79—80	—	—	—	—	—	—	—	—	—	—	·5	·5	—	·25	·25	—	—	—	1·5
80—81	—	—	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	—	·5
81—82	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	·5	—	—	—	1
Totals	1·5	3	14	30·5	41	80	114·5	130·5	161·5	148	123	86	55	32·5	20·5	13	9·5	4	1068

TABLE XXX.

Mother's Forearm and Son's Forearm.

Mother's Forearm.

Son's Forearm.

	13—13·5	13·5—14	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	Totals
14—14·5	—	—	—	—	—	—	—	1	—	—	—	—	—	1
14·5—15	—	—	—	·5	·5	—	—	—	—	—	—	—	—	1
15—15·5	—	—	—	·5	·5	—	—	—	—	—	—	—	—	1
15·5—16	—	—	·25	2·75	—	·25	·75	·25	·25	—	—	—	—	4·5
16—16·5	—	—	·25	·75	1	2	2·5	1	1	—	—	—	—	8·5
16·5—17	—	—	2	3·75	6	10·25	9	4·25	1	·25	—	—	—	36·5
17—17·5	—	·25	1·25	5·5	10·5	25·5	21·75	14	5·5	·75	—	—	—	85
17·5—18	—	·25	1·5	4·25	16·75	38·5	44	33·5	15·75	6·75	·5	·25	—	162
18—18·5	—	—	1·25	4·5	16·25	40	68·5	54·25	33·25	15·5	5	·5	—	239
18·5—19	—	—	·75	3·5	10	28·75	53·5	50	36·25	14·25	5·5	2·25	1·25	206
19—19·5	—	—	·25	3	4	18·5	30·5	42·5	34·75	14·75	7	3	1·25	159·5
19·5—20	·25	·25	·25	1	·75	5·25	16·5	24·5	21·75	12	8·75	2·5	·75	94·5
20—20·5	·25	·25	·25	·5	·25	1·5	8	7	8·75	5·5	4·5	1	·25	38
20·5—21	—	—	—	—	—	·25	1·75	3·25	2·5	3·5	3	·75	—	15
21—21·5	—	—	—	—	—	1·25	·75	—	·75	1·25	2·25	1	·25	7·5
21·5—22	—	—	—	—	—	—	1·5	1	—	—	—	·75	·75	4
Totals	·5	1	8	30·5	66·5	172	259	236·5	161·5	74·5	36·5	12	4·5	1063

TABLE XXXI.

Mother's Stature and Daughter's Stature.

Mother's Stature.

Daughter's Stature.	52—53	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	Totals
52—53	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1·5
53—54	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
55—56	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
56—57	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
57—58	—	—	—	—	—	1·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1·5
58—59	—	—	—	—	—	·5	1·25	2·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2·5
59—60	—	—	—	—	—	—	2·25	—	2·75	—	—	—	—	—	—	—	—	—	—	—	—	—	5·25
60—61	—	—	—	—	—	—	—	2·75	4·75	2	4	3·75	2·5	·25	—	—	—	—	—	—	—	—	17·5
61—62	—	—	—	—	—	—	—	—	2	8	11·5	6·25	4	1	1·25	—	—	—	—	—	—	—	34·5
62—63	—	—	—	—	—	—	—	—	4·75	9·25	18·5	19·75	17·5	6·25	3·25	1·5	·5	—	—	—	—	—	108·5
63—64	—	—	—	—	—	—	—	—	19·5	18·25	33·25	29	23·75	10·5	10·25	14·75	7·75	5·5	—	—	—	—	168·5
64—65	—	—	—	—	—	—	—	—	15·75	34	34·75	41·5	32	18	14·75	7·75	1·5	—	1	1	—	—	212
65—66	—	—	—	—	—	—	—	—	17	27·25	34·75	46·5	38·5	27·5	23	7·75	5·75	1	1	—	—	—	235
66—67	—	—	—	—	—	—	—	—	15	24	33·5	40	35	26	29·25	15	6·5	2·5	1	·5	—	1	213·5
64—65	—	—	—	—	—	—	—	—	3·25	8·75	12·75	18·25	27·75	16·5	21·75	14·25	4·75	5·25	1	—	—	—	145·5
66—67	—	—	—	—	—	—	—	—	1·5	3·25	9·75	3·75	3·5	12·25	15·75	8·25	3·25	3·25	1·25	·75	—	—	61·5
67—68	—	—	—	—	—	—	—	—	·25	·25	1	·5	1·5	3·25	2·75	5	4·75	·75	2	·5	—	—	22·5
68—69	—	—	—	—	—	—	—	—	1	—	·5	·5	·5	—	2	1·25	1·25	1	1	—	—	—	9
69—70	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	·5	·5	1	1·5	·5	—	—	—	5
70—71	—	—	—	—	—	—	—	—	·5	·5	—	—	—	·5	—	1	—	·5	·5	1	—	—	4
Totals	1·5	·5	·5	2·5	8	24	51·5	108·5	168·5	212	235	213·5	145·5	101·5	61·5	22·5	9	5	4	1	1	—	1375

TABLE XXXII.

Mother's Span and Daughter's Span.

Mother's Span.

Daughter's Span.	52—53	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	Totals
53—54	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	·25	·25	—	—	1	—	—	·25	·25	—	—	—	—	—	—	—	2
55—56	—	—	—	—	·5	—	1	—	—	—	—	·25	·25	—	—	—	—	—	—	—	2
56—57	—	—	—	—	2	·5	1·75	1·75	·5	—	—	—	—	—	—	—	—	—	—	—	6·5
57—58	—	·5	—	·5	1·75	4	5	1·25	2	1	·5	·5	—	—	—	—	—	—	—	—	17
58—59	—	·75	·5	3	3	4	8·5	11·5	10·75	1	3·25	2·75	1·75	·75	—	1	—	—	—	—	52·5
59—60	—	·25	·5	5·5	6·25	7·75	8·5	14·5	10	5·75	7·75	9·25	4·5	3·5	1	1	—	—	·25	·25	86·5
60—61	—	1	·5	2·75	9·5	8·75	12·5	21·5	20·5	16·75	13·75	8	6·75	4·75	1·5	·5	·5	—	·25	·25	130
61—62	·5	—	·5	3·75	4·5	6·5	14·25	17·5	26·25	26·5	22·25	15·5	13	3·25	1·75	·5	·5	—	·25	·25	157·5
62—63	·5	—	1·5	1·5	4·75	5·75	14	31	30·75	27·5	28·5	14·75	14	6·75	1·25	1·5	—	—	·25	·25	184·5
63—64	—	—	—	1	2·75	3·5	6·25	23·5	33·5	27·25	30·5	20·5	16	10·75	4·5	1·5	·5	—	—	—	182
64—65	—	—	·5	·5	3	2·75	8	19·75	18·75	24·5	32	22·75	15·25	12·5	2·5	·75	3·25	1·25	—	—	168
65—66	—	—	—	—	2·5	5	7·5	11·75	14·5	17·25	22·25	18·5	15·75	13	5·75	2·75	3·75	2·25	·5	—	143
66—67	—	—	—	—	1	2	1·25	4·25	5·5	13	19	9·25	10·75	8·25	5·25	4·5	2	·5	·5	—	87
67—68	—	—	—	—	—	—	1·5	2·5	3·75	6·5	17·5	11·75	8·75	4·75	7·75	2	1	1·25	—	—	69
68—69	—	—	—	—	—	—	·5	1·5	4·5	4	3·5	3·75	5·25	7·25	3	2·5	4·5	2·75	·5	—	43·5
69—70	—	—	—	—	—	—	—	·25	1·75	1·5	·75	2	5	4	2·25	2·5	·5	1	·5	—	22
70—71	—	—	—	—	—	—	—	—	—	—	—	1·25	1·25	1	1·25	1	·25	·5	1·5	—	8
71—72	—	—	—	—	—	—	—	—	—	—	1	1·5	·5	—	1·25	1	·25	·25	·25	—	6
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	—	·5
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
74—75	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	·5	—	1
75—76	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	·5	—	1
Totals	1	2·5	4	18·5	42	51	90·5	162·5	184	172·5	202·5	143·5	119	80·5	39	23	17	10	6	1	1370

Son's Span.

Totals	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80
·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
52·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
86·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
130	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
157·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
184·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
182	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
168	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
143	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
87	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
69	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
43·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daughter's Forearm.

TABLE XXXIII.

Mother's Forearm and Daughter's Forearm.

Mother's Forearm.

Daughter's Forearm.	13–13·5	13·5–14	14–14·5	14·5–15	15–15·5	15·5–16	16–16·5	16·5–17	17–17·5	17·5–18	18–18·5	18·5–19	19–19·5	19·5–20	Totals
13·5–14	—	—	—	—	—	—	—	·5	1	—	—	—	—	—	1·5
14–14·5	—	—	1	·25	·25	·25	·75	1·5	1	—	—	—	—	—	5
14·5–15	·25	·25	·25	2	3·5	2	3·75	3·5	1·75	·25	·25	·25	—	—	18
15–15·5	·25	·25	1·25	6·25	11·5	17	14	7·25	6·75	1·5	·25	·25	—	—	66·5
15·5–16	—	—	1·5	11	23·75	47·25	42	24·75	16	4·5	1	·25	—	—	172
16–16·5	—	·75	1·75	8	27·75	64·75	86·75	63·5	35·25	11·5	3·25	·25	—	—	303·5
16·5–17	—	·25	1·5	6·25	14·75	48·5	80·5	77	43	19	6·75	1·5	1	—	300
17–17·5	—	—	·25	3·25	8·75	30	54·75	66·5	52·25	16·75	8·75	1·75	1	—	244
17·5–18	—	—	—	·25	2	10·5	27·75	39·5	30	22·5	12·5	2·25	·75	—	148
18–18·5	—	—	—	·5	1·5	4·25	4·25	14·5	22·5	12·75	8	3·5	1·75	—	73·5
18·5–19	—	—	—	·25	·25	·25	1·25	3·75	6·75	3·25	2·75	3·5	1·5	—	23·5
19–19·5	·25	·25	—	—	—	·5	·5	1·75	2·25	1·25	2·25	·5	·5	—	10
19·5–20	·25	·25	—	—	—	·25	·25	—	1	·25	·25	—	·25	·25	3
20–20·5	—	—	—	—	—	—	—	—	—	—	—	—	·5	·5	1
20·5–21	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	·5
Totals	1	2	7·5	38	94	225·5	316·5	304	219·5	93·5	46	14	7·5	1	1370

TABLE XXXIV.

Father's Stature and Son's Span.

Father's Stature.

Son's Span.	58–59	59–60	60–61	61–62	62–63	63–64	64–65	65–66	66–67	67–68	68–69	69–70	70–71	71–72	72–73	73–74	74–75	75–76	Totals
58–59	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	·5
59–60	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	·5
60–61	—	—	—	—	—	—	1	·5	—	—	—	—	—	—	—	—	—	—	1·5
61–62	—	—	—	—	—	—	—	·5	1	1	—	—	—	·25	·25	—	—	—	3
62–63	—	—	—	·5	·5	—	1	·25	·25	1	—	·25	·25	·25	·25	—	—	—	4·5
63–64	—	—	—	—	1	1	1·5	3·5	4·75	1·75	—	·25	·25	—	—	—	—	—	14
64–65	—	—	—	1·75	1·5	3·5	1·25	4·75	3	4·75	4	2	1·25	·5	·25	—	—	—	28·5
65–66	·25	·25	·5	3·75	5·25	4·75	5·75	8·5	9·75	10·5	4·25	4·75	·5	5	·25	·25	·25	—	60
66–67	·25	·5	1·75	3·25	4·75	6·25	10·25	12·25	13	9	8	5·75	3·25	1·5	·25	·25	·25	—	80·5
67–68	—	1·25	1·75	·75	4·25	6·25	11·25	16	20	11·75	12·25	5·5	4·25	2·5	2·25	—	—	—	100
68–69	—	1	—	1·25	5·5	5·75	13·5	17·25	18·25	17·25	14	9·75	12·25	5·75	1·5	·5	—	—	123·5
69–70	—	—	1	·75	2	5·5	9	24·25	19·5	20	22·5	15·25	11·25	4	1·75	·25	·5	·5	138
70–71	—	—	—	·5	2·75	3·25	8	19	16	20·75	27·25	21·5	14·25	5·5	3	1	·25	—	143
71–72	—	—	—	—	1	4	8	7·75	11·75	13·75	15	19·25	14	9·75	4·25	1·25	·75	·5	111
72–73	—	—	·5	·75	1·5	1·5	3·5	5·5	7·75	17·5	14·5	11·25	8·5	10	5	3·25	1	—	92
73–74	—	—	—	·25	1	1	3·75	3·75	6·5	9·75	9·25	9·75	13·25	8·25	3·75	·75	1·5	·5	73
74–75	—	—	—	—	—	·75	·25	2·5	3·25	4·75	8·75	5	7·75	5·25	5	1·25	—	1	45·5
75–76	—	—	—	—	—	—	1·5	·75	·25	—	6·25	2·75	3·5	3·75	4·5	2·25	—	—	25·5
76–77	—	—	—	—	—	—	·5	—	—	·5	1·5	1	3·25	1	·75	1·5	—	—	10
77–78	—	—	—	—	—	—	—	—	—	—	3	1	1	2·5	—	—	—	—	7·5
78–79	—	—	—	—	—	—	—	—	—	—	3·5	1	·25	·25	·75	·75	—	—	6·5
79–80	—	—	—	—	—	—	—	—	—	—	—	—	1	—	·75	·25	—	—	2
80–81	—	—	—	—	—	—	—	—	—	—	—	—	1	—	·5	—	—	—	1·5
Totals	·5	3	5·5	13·5	31	44·5	80	127	135	144	154	116	101	61·5	35	13·5	4·5	2·5	1072

TABLE XXXV.

Father's Span and Son's Stature.

Father's Span.

Son's Stature.	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	*72—73*	*73—74*	*74—75*	*75—76*	*76—77*	*77—78*	*78—79*	*79—80*	*80—81*	Totals
59—60	·25	·25	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
60—61	·25	·25	—	·25	·25	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	1·5
61—62	—	—	—	—	—	—	—	—	—	·75	·75	—	—	—	—	—	—	—	—	—	—	—	1·5
62—63	—	—	—	·5	·5	2·5	2	1·75	1	·5	·5	·25	—	—	—	—	—	—	—	—	—	—	9·5
63—64	—	·25	·75	·75	4	9·25	3	1·75	4	3	1·5	1·25	·75	·75	—	—	—	—	—	—	—	—	31
64—65	·25	1	1·25	·75	2·5	7·75	6·75	6	5·25	7	2·75	6	1	1·5	·25	—	—	—	—	—	—	—	50
65—66	·25	·75	1·5	2·25	3·75	12·5	6·5	13·75	6·25	8	7·5	4	3·25	3·5	·25	—	—	—	—	—	—	—	74
66—67	—	1	1·25	3·5	2·5	8·75	9	23	19·75	15·5	8·75	10·25	6·25	2	3	·25	·25	—	—	—	—	—	115
67—68	—	3	3	2	4·5	7·25	13	20·25	27·75	27·25	22·75	13	9·25	6	5	1·25	2·25	—	—	—	—	—	167·5
68—69	·25	·25	1·75	1·75	2·25	11·75	15·25	14·5	19·5	24	26·75	21	14·75	9·75	6·5	2	1·5	1	—	1	—	—	175·5
69—70	·25	·25	—	1·25	·25	4	7	11	15·25	17·25	13·25	13·75	17·75	9·25	5·75	3·5	1·75	1	—	—	—	—	122·5
70—71	—	—	—	2	2	4·75	5·25	10·75	10·75	18·75	17·25	18	11	10	5·25	4·5	1·25	2·5	·5	2	—	—	126·5
71—72	—	—	—	·75	·25	2·5	4·25	6	10	6·5	10·25	7·75	7·75	7	6	5·75	3	1·25	—	—	—	—	79
72—73	—	—	—	—	1	—	1·5	1·25	5	4·75	6·5	3·5	7·5	7	7	1·75	2	·25	—	—	—	—	49
73—74	—	—	—	1	—	1	—	2·25	3·75	4·25	4·75	6	4·25	4·25	1	3	1·5	—	—	—	—	—	37
74—75	—	—	—	—	—	—	1	·25	1	2	2	5·25	·5	2	·5	·75	1·25	—	—	—	—	·5	17
75—76	—	—	—	—	—	—	—	—	·75	·75	·5	·5	—	1·5	·5	·25	1	·25	—	—	—	·5	6·5
76—77	—	—	—	—	—	—	—	—	—	—	—	—	2	·25	·25	—	·75	·25	—	—	—	—	3·5
77—78	—	—	—	—	—	—	—	—	·5	—	·5	—	—	·25	·25	—	—	—	—	—	—	—	1·5
78—79	—	—	—	—	—	—	—	—	·5	—	·5	—	—	—	—	—	·5	·5	—	—	—	—	2
79—80	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
Totals	1·5	7	9·5	17	24	72	74·5	112·5	131	140·5	128	110·5	86	65	41·5	23	17	7	·5	3	—	1	1072

Son's Forearm.

Son's Stature.	*14—14·5*	*14·5—15*	*15—15·5*	*15·5—16*	*16—16·5*	*16·5—17*	*17—17·5*	*17·5—18*	*18—18·5*	*18·5—19*	*19—19·5*	*19·5—20*	*20—20·5*	*20·5—21*	*21—21·5*	*21·5—22*	Totals
59—60	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
60—61	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1·5
61—62	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1·5
62—63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9·5
63—64	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	31
64—65	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	50
65—66	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	74
66—67	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	115
67—68	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	167·5
68—69	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	175·5
69—70	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	122·5
70—71	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	126·5
71—72	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	79
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	49
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	37
74—75	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17
75—76	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6·5
76—77	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3·5
77—78	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1·5
78—79	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
79—80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Totals	·5	1·5	2·5	5·5	9·5	15·5	19·5	19·5	19·5	15·5	12·5	8·5	5·5	2·5	1·5	·5	1072

TABLE XXXVI.

Father's Stature and Son's Forearm.

Father's Stature.

Son's Forearm.	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	Totals
14—14·5	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
14·5—15	—	—	—	—	—	—	—	·5	—	—	·25	·25	—	—	—	—	—	—	1
15—15·5	—	—	—	—	—	—	—	·5	—	—	·25	·25	—	—	—	—	—	—	1
15·5—16	—	—	—	—	·25	·25	·25	·75	—	·5	·5	—	—	—	—	—	—	—	2·5
16—16·5	—	—	—	—	1	1·5	1	1	·75	2·5	·75	—	—	—	—	—	—	—	8·5
16·5—17	·5	·5	—	1	2·25	2·5	4·5	4	7·75	6·75	3	·75	1·25	·25	—	—	—	—	35
17—17·5	—	·5	·5	4·25	3·5	6·5	10·75	16·5	16	9·5	4·25	4·75	2·5	1·5	—	—	—	—	81
17·5—18	—	1	2·5	3	4·5	7·5	14·75	25·25	24	20	15·25	14·75	8·5	4·25	3·25	—	·5	·5	149·5
18—18·5	—	1·5	1	1·5	5	11·5	18·25	27·5	30·5	31·5	30·5	25	20·25	8·75	3	1	·75	·5	218
18·5—19	—	—	—	·5	1·5	5·75	9·25	21·5	25	24·75	30·75	28·75	23·25	15	6·5	3·25	·25	—	196
19—19·5	—	—	—	·25	1·5	2·75	8·25	9	17·75	22·75	26·75	23	20·75	12·5	7·25	4	1·5	·5	158·5
19·5—20	—	—	—	—	·75	1	5·5	6·25	7·25	13	17	9·25	9·5	8·25	6·75	3·25	·25	1	89
20—20·5	—	—	—	—	·25	·25	2	2·25	1·5	5	8·5	2·75	3·75	4	2·75	2·25	1·25	—	36·5
20·5—21	—	—	—	—	—	—	·5	·75	·25	·25	3·75	2	1·25	1·5	1·75	5	—	—	12·5
21—21·5	—	—	—	—	—	—	—	·25	·25	—	1·5	·5	1·5	1	1·75	·25	—	—	7
21·5—22	—	—	—	—	—	—	—	—	—	—	—	1·5	1·5	—	—	—	—	—	3
Totals	·5	3·5	4	10·5	20·5	39·5	75	116	131	136·5	144	113·5	94	57	33	14·5	4·5	2·5	1000

TABLE XXXVII.

Father's Forearm and Son's Stature.

Father's Forearm.

Son's Stature.	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
59—60	—	—	—	·25	·5	·25	·5	—	—	—	—	—	—	—	—	1·5
60—61	—	—	—	·25	·5	·25	·5	·25	·25	—	—	—	—	—	—	2
61—62	—	—	—	—	—	·5	·5	·25	·25	—	—	—	—	—	—	1·5
62—63	—	—	·5	·75	4·25	2·5	1·25	·5	·25	—	—	—	—	—	—	10
63—64	—	·75	2·75	4·5	6·25	8·5	4	2·75	·75	·25	—	—	—	—	—	30·5
64—65	·25	1·5	1·75	5·5	8·75	17·5	9·75	4·5	2·75	1	·25	—	—	—	—	53·5
65—66	·25	1·75	2·5	7	16·75	17·5	12·75	9·25	5·5	·5	·25	·25	·25	—	—	74·5
66—67	—	·5	2·5	9	18	25·75	29·5	17	6·5	1	1·75	·75	·75	—	—	113
67—68	·75	1·5	4·75	7·5	16·25	39·25	36·75	30·75	17·25	7·75	3	1·25	·25	—	—	167
68—69	·75	2	3	7·25	19·75	26	44·5	35	22	11	1·75	1·25	·75	·25	·25	175·5
69—70	—	—	1·25	1·25	12·75	19·5	23·75	29·5	20·5	12·25	2·25	1·25	·25	·25	·25	125
70—71	—	—	·75	3·75	10·75	20·25	26·5	23·25	22·75	9·25	4·25	1·5	·5	—	—	123·5
71—72	—	—	·75	2·25	3·75	11·25	17·25	13·5	19	6	4·75	1·25	·25	·25	·25	80·5
72—73	—	—	—	·75	2·25	7	8·5	5·5	11·75	6·75	4	·5	·25	·75	·5	48·5
73—74	—	—	—	·25	·75	5	8·25	7·75	5	5	2	—	·25	1	·75	36
74—75	—	—	—	·25	·25	3·75	5	2	1·25	1·25	2	1·5	·25	—	—	17·5
75—76	—	—	—	—	—	·25	1·25	·25	1	1·25	1·25	·5	·25	—	—	6
76—77	—	—	—	—	—	—	·5	1	1·25	·25	·5	—	—	—	—	3·5
77—78	—	—	—	—	—	·25	·5	·25	·5	—	—	—	—	—	—	1·5
78—79	—	—	—	—	—	·25	·5	·25	·5	·5	—	—	—	—	—	2
79—80	—	—	—	—	—	—	·5	·5	—	—	—	—	—	—	—	1
Totals	2	8	20·5	50·5	121·5	205·5	232·5	184	139	64	28	10	4	2·5	2	1074

TABLE XXXVIII.

Father's Span and Son's Forearm.

Father's Span.

Son's Forearm.	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	Totals
14—14·5	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
14·5—15	·25	·25	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	1
15—15·5	·25	·25	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	1
15·5—16	—	—	—	—	1	1·25	1	·25	·75	·25	·25	·25	—	—	—	—	—	—	—	—	—	—	5
16—16·5	—	—	·25	·75	·75	·5	1·75	·5	2·25	·75	1	·5	—	—	—	—	—	—	—	—	—	—	9
16·5—17	·5	·5	·25	1·25	2·75	5	5	4	9·25	4·25	2·25	·75	·25	·25	·25	—	—	—	—	—	—	—	36·5
17—17·5	—	1·25	1·75	2·25	4·25	13·75	12	16·25	7·25	12·25	5	4·5	1·75	1·5	·75	—	—	—	—	—	—	—	84·5
17·5—18	—	2·5	2·25	1·75	4·75	19	12·75	23·5	20·75	22·75	18	13·75	7·5	6·75	3·5	1·5	1	1	—	1	—	—	164
18—18·5	—	1·25	4	2·75	6	16·25	19·5	27·25	31·75	34	27·5	25·25	17	12	7·75	1·75	2·5	1·25	·25	1	—	—	239
18·5—19	·5	·75	1·75	3	2	6·25	11·25	18·75	29·5	30·5	25	28·75	19·5	14	8·25	3·75	3·5	·75	·25	—	—	—	208
19—19·5	—	·25	1·25	1·75	1·5	5	5	14·25	15·75	19·5	20·75	22·25	21	14·25	9	3·5	2·5	1·5	—	—	—	—	159
19·5—20	—	—	·5	2·25	·75	1·75	4	5·5	5·5	8	18	10	10·5	9·5	8	5	5	·75	—	1	—	—	96
20—20·5	—	—	—	·25	·25	·75	1·75	1·25	4·5	3·75	4·25	1·5	5·75	4·25	3·5	3·5	2	·25	—	—	—	·5	38
20·5—21	—	—	—	—	—	·75	·75	—	1·25	2·75	1·25	·5	1·5	2	·75	·5	·75	·25	—	—	—	·5	13·5
21—21·5	—	—	—	—	—	·25	·25	—	·5	·75	1·25	—	·75	1·5	·25	1	·75	·25	—	—	—	—	7·5
21·5—22	—	—	—	—	—	—	—	—	·5	—	2·5	—	—	—	—	—	—	1	—	—	—	—	4
Totals	1·5	7	12	16	24	70·5	75	111·5	130·5	140·5	127	108	85·5	66	42	20·5	18	7	·5	3	—	1	1067

TABLE XXXIX.

Father's Forearm and Son's Span.

Father's Forearm.

Son's Span.	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
58—59	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	·5
59—60	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	·5
60—61	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	·5
61—62		—	—	·25	1·25	—	—	·5	·75	·25	—	—	—	—	—	3
62—63	—	—	—	—	1·5	1·5	·5	—	·5	·5	—	—	—	—	—	4·5
63—64	—	—	·5	1·5	2·75	4·75	2·25	1·25	·25	·25	—	—	—	—	—	13·5
64—65	·5	·75	1·75	1	5	7·5	6	3·75	1	1	·25	—	—	—	—	28·5
65—66	·5	3·25	5·75	5·25	10·75	13·25	10·25	6·5	2·25	1	·5	·25	—	—	—	59·5
66—67	—	1	4·5	10·25	16·75	18	14·25	7·75	4·25	·75	·25	·5	·25	—	—	78·5
67—68	·75	1·25	1·25	8·25	17·25	25·75	24	12	6·25	1·75	1	·5	·5	—	—	100·5
68—69	·25	1	1·5	6·5	15·25	27·5	27·75	22·5	14·25	5·25	1·75	·25	·25	—	—	124
69—70	—	·25	1·5	6·5	15·25	27	32	30·5	15	5·75	·75	1·5	·5	—	—	136·5
70—71	—	·25	·75	3·75	13·25	28	37·25	29·25	22	5·75	2·25	·5	—	—	—	143
71—72	—	·25	1	2·75	7·75	19·5	24·75	24·25	18·5	8·75	1·5	1·25	·25	·5	·5	111·5
72—73	—	·5	1	1·5	6·75	13·75	20·5	18	16	8·75	3·5	·5	·25	·5	·5	92
73—74	—	·25	·75	1·5	2·5	10	17	10·75	15	6·75	6·75	1·75	·75	·5	·25	74·5
74—75	—	·25	·25	·25	2·75	4·25	5·5	6·5	9·75	7·5	2·5	·5	·25	·5	·25	41
75—76	—	—	—	—	·25	1·75	1·75	4·25	8·5	7	3·5	·75	·25	—	—	28
76—77	—	—	—	—	·25	1·25	2	1·25	·5	·25	1	·75	·25	—	—	7·5
77—78	—	—	—	—	—	·25	1·25	1·75	1·5	1	·75	—	—	·5	·5	7·5
78—79	—	—	—	—	—	·5	2·25	1	1·25	1·25	1·25	·25	·25	—	—	8
79—80	—	—	—	—	—	—	·25	·25	·25	·25	—	·25	·25	—	—	1·5
80—81	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	·5
81—82	—	—	—	—	—	—	·5	·5	—	—	—	—	—	—	—	1
Totals	2	9	20·5	49·5	120	205	230	182·5	138	64	27·5	9·5	4	2·5	2	1066

TABLE XL.

Father's Stature and Daughter's Span.

Father's Stature.

Daughter's Span.	*58—59*	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	*72—73*	*73—74*	*74—75*	*75—76*	Totals
52—53	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
53—54	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	1	·25	·25	·25	·25	—	—	—	—	—	—	—	—	—	2
55—56	—	—	—	—	1	—	—	·25	·75	—	—	—	—	—	—	—	—	—	2
56—57	—	—	—	·75	·25	—	—	1·5	3	·75	·25	—	—	—	—	—	—	—	6·5
57—58	—	—	—	·75	1	1·5	2·5	3·75	2·5	2·25	1·25	1·5	—	—	—	—	—	—	17
58—59	—	—	2	1·5	8·75	4	4	7·5	11·25	4	5	4	·5	—	—	—	—	—	52·5
59—60	·5	·5	1	·5	6·25	4·75	9·25	13	19·75	14·25	10	3·25	1·75	·25	·25	·75	—	—	86
60—61	·5	·5	—	1	7·75	8·5	13·25	19·75	23·75	15·25	13·25	11·75	8·25	3	·75	1·25	·5	—	129
61—62	—	1·75	2	2	5·5	10	16	23·25	29·25	20	19·75	8·5	10·75	5·75	2·5	—	—	—	157
62—63	—	·25	·5	2·25	6·75	8·75	15·25	25·25	22·25	25·75	30·25	19·25	13	7·5	4·5	·5	1	—	183
63—64	—	1·5	·5	1·25	5·25	6·25	10·5	17·5	20	30·5	29	24·5	21·25	11·5	4	·75	·25	—	184·5
64—65	—	—	·25	·75	1	2·25	10·25	17·75	17·75	21·25	25	28	20·5	12·5	6	3·75	·5	1	168·5
65—66	—	—	·25	·25	·75	2·75	5	10·75	10·75	17	25·75	27·25	17·5	11·5	5·75	3·75	·75	2·25	142
66—67	—	—	—	—	·75	1·25	4	10	7	9	15·5	11·5	12·25	11	3·5	2·5	1·5	·25	90
67—68	—	—	—	—	—	—	1·5	4·25	5·75	9·5	11·75	13·5	10	7·75	3·5	1·5	1	·5	70·5
68—69	—	—	—	—	—	·5	·5	·25	2·75	2	4·5	5·75	12	8·25	4·75	1·75	·5	·5	44
69—70	—	—	—	—	—	1·5	—	—	1·25	1·5	5	3	1·75	2·5	3	2·75	·25	—	22·5
70—71	—	—	—	—	—	—	—	·5	·5	—	2·25	1·75	3·5	—	—	·25	·25	—	9
71—72	—	—	—	—	—	—	—	—	—	—	·5	·5	2·5	1	1·5	—	—	—	6
72—73	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	·5
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
74—75	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	·25	·25	—	—	1
75—76	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	·25	·25	—	—	1
Totals	1	4·5	6·5	11	46	52·5	92·5	155·5	178·5	173	200	164	136	82·5	40·5	20	6·5	4·5	1375

TABLE XLI.

Father's Span and Daughter's Stature.

Father's Span.

Daughter's Stature.	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	Totals
52—53	—	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
53—54	—	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55—56	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
56—57	·25	·25	·25	·25	·25	1	·75	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3·5
57—58	·25	·25	·75	·75	1	2·75	2	2·25	2	2	—	·25	·25	—	—	—	—	—	—	—	—	—	14·5
58—59	—	·25	·75	·25	1·25	1	3·5	4·75	2·25	·5	—	·25	·25	—	·5	—	—	—	—	—	—	—	15·5
59—60	—	1·25	·25	·75	4·75	6·25	5·25	8·5	5·75	4·25	3·5	2	2	2	·5	—	—	—	—	—	—	—	47
60—61	·5	·5	·75	2·75	3	11·5	13·25	15·75	17·75	13	8·75	3·75	2·25	3·25	1·25	·5	·5	·5	·5	—	—	—	100
61—62	·5	1·5	4	5	7	10·25	12·5	20	20·5	14	18·5	9·25	6·5	7	2	1·5	·5	—	—	—	—	—	140·5
62—63	—	1	3·75	2	7·5	17·5	20	16	32·25	22	19·5	21·25	13·25	5·5	5·5	2·25	·25	—	—	—	—	—	189·5
63—64	—	1·5	1·5	4	3·75	11·25	13·25	19·75	31·25	39·5	27·5	26	11·75	9·5	4	2·25	1·25	·5	—	—	—	—	208·5
64—65	·5	1	·5	2·75	2	9·75	9·75	17	19	26	32·25	28	18·5	13·25	9·75	3·5	2·5	1·5	1	·5	—	—	199
65—66	·5	·5	—	2	2	3·25	5·75	11·5	12·5	21	27·5	23	13·25	10·25	11	6	5	3	·5	1	—	—	159·5
66—67	—	—	—	—	2	1·5	5	7·25	10·25	21	18	14	18	18·5	8·75	6·25	5	2·25	·25	1	—	—	139
67—68	—	—	—	—	1	2·75	5·25	3·25	3·75	11·5	10·25	7·25	12	6·25	5·5	2·5	3·25	·75	·25	·5	—	·5	76·5
68—69	—	—	—	—	—	·25	1·25	1·5	3·5	1·5	4·75	4·5	4·5	4	3·25	2·25	1·75	1	—	—	—	·5	34·5
69—70	—	—	—	—	—	—	—	1·5	1	·5	1	1·5	2·5	3	·25	2·25	3	·5	—	—	—	—	17
70—71	—	—	—	—	—	—	—	1	·25	·75	·5	2	—	1·75	1	1·25	—	—	—	—	—	—	8·5
71—72	—	—	—	—	—	—	—	·5	—	·5	·5	—	—	·25	·25	—	1	1	—	—	—	—	4
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73—74	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
Totals	2·5	8	12·5	20·5	35·5	80	98	131·5	162	178	172·5	143	106	84·5	53·5	30·5	24	11	2·5	3	—	1	1360

TABLE XLII.

Father's Stature and Daughter's Forearm.

Father's Stature.

Daughter's Forearm.	*58—59*	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	*72—73*	*73—74*	*74—75*	*75—76*	Totals
13·5—14	—	—	—	—	—	·25	·25	·25	·25	—	·5	—	—	—	—	—	—	—	1·5
14—14·5	—	—	—	—	·25	·5	·25	·5	2	—	1·5	—	—	—	—	—	—	—	5
14·5—15	—	—	—	·75	3	1·75	1·25	2·75	4	1·75	·75	1	—	—	—	·25	·25	—	17·5
15—15·5	·25	·25	·5	1·25	9	4·75	5	7·25	14·75	9	5·5	5	1·75	·75	—	·25	·25	—	65·5
15·5—16	·25	1	1·75	2·75	8·75	12·25	17	20·75	34·25	21·75	22·75	11·75	8·5	5·75	1·25	1·5	—	—	172
16—16·5	—	1	1·5	3	8·25	13·75	28	44·5	46·75	43·75	44·5	31·25	19·75	11	3·75	1·25	·5	—	302·5
16·5—17	·5	1·5	1·75	2	10·5	10·5	20·75	38·25	33	40·25	37·5	38·25	31·75	19·5	9·5	5	1	—	301·5
17—17·5	—	·75	·5	·25	4·75	5·5	12	25·25	24·25	34	38·25	33·5	29	20·75	8	3·75	2	2·5	245
17·5—18	—	—	·25	·5	·75	2·25	5	7·75	12·25	14	28	26	21·25	15·25	7·25	4	2	2	148·5
18—18·5	—	—	·25	·5	·5	·75	·5	6	6·25	7·5	11·5	12	14·5	5·5	5·75	3	—	—	74·5
18·5—19	—	—	—	—	·25	·25	—	1·5	1·25	·75	5·75	3·75	5·5	2·25	1·25	·5	—	—	23
19—19·5	—	—	—	—	—	—	—	·25	·75	·5	3	1	1·5	1·25	1·75	·75	·25	—	11
19·5—20	—	—	—	—	—	—	—	—	·25	·25	·5	—	1	·5	—	·25	·25	—	3
20—20·5	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
20·5—21	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	·5
Totals	1	4·5	6·5	11	46	52·5	90	155	180	173·5	200	163·5	136	82·5	38·5	20·5	6·5	4·5	1372

TABLE XLIII.

Father's Forearm and Daughter's Stature.

Father's Forearm.

Daughter's Stature.	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
52—53	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	·5
53—54	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55—56	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
56—57	—	·5	—	1·25	2·5	·25	—	—	—	—	—	—	—	—	—	4·5
57—58	—	·5	—	3·75	4·25	3·5	2	—	—	—	—	—	—	—	—	14
58—59	—	·25	·75	1·75	2·75	5·5	3·5	·75	·25	—	—	—	—	—	—	15·5
59—60	·25	1	2·25	6	8	11·5	7·25	6·75	3	1	·5	—	—	—	—	47·5
60—61	·25	1·75	2·5	7·25	14	26·25	29	10·75	4·75	·75	1·25	·5	—	—	—	99
61—62	—	1·25	3·5	8·75	24·75	32	36	19·5	7·25	2·75	2·75	1·25	·75	—	—	140·5
62—63	—	1·25	4	12·25	30·25	42·25	40·5	28·5	24·75	6	1·75	·25	·25	—	—	192
63—64	—	·75	3·25	6·5	25	43	56	42	19·25	7·75	4·5	2	1	·5	·5	212
64—65	—	·25	2·25	5·75	21·25	28·75	49	39·25	28·25	13	4·25	2	2	1	·5	197·5
65—66	—	—	·5	3·5	10·75	21·25	38	33·75	27·5	15·25	6·75	·75	·5	—	—	158·5
66—67	—	—	·5	2	7	15·75	31·75	34	30·25	13	4·75	1·5	·5	—	—	141
67—68	—	·5	·5	·75	4·25	7·25	15·25	15·25	15	9·75	5	1·5	·5	·25	·25	76
68—69	—	—	—	2	1·75	3	5·75	7·75	4·5	4·5	4	1·25	·5	·25	·25	35·5
69—70	—	—	—	—	1	1	2	2·25	3·25	3·75	2·25	1·5	—	·5	1·5	19
70—71	—	—	—	—	—	·25	1·5	2·5	3	1·25	·75	·25	—	—	—	9·5
71—72	—	—	—	—	—	—	·5	·5	1	·25	1·5	·25	—	—	—	4
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73—74	—	—	—	—	—	—	—	·5	·5	—	—	—	—	—	—	1
Totals	·5	8	20	63	158	241·5	318	244	172·5	79	40	13	6	2·5	3	1369

TABLE XLIV.

Father's Span and Daughter's Forearm.

Father's Span.

Daughter's Forearm.	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	Totals
13·5—14	—	—	—	·25	·25	—	·25	·25	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	1·5
14—14·5	—	—	—	·25	·5	·25	·5	2	—	1·25	·25	—	—	—	—	—	—	—	—	—	—	—	5
14·5—15	—	—	·5	1·75	1·25	3·5	2	3·75	2·25	1·25	1·25	—	·25	·25	—	—	—	—	—	—	—	—	18
15—15·5	·25	·75	1·5	2·25	3·5	7	7·75	8	11·25	8·5	5·5	5	3·75	1·25	·25	—	—	—	—	—	—	—	66·5
15·5—16	·5	2·75	3	5	6	15·5	25·25	24·75	23	21·5	14	11·5	6	6·75	5·25	·5	·25	—	—	—	—	—	171·5
16—16·5	·25	2·25	3	4	10·75	24	29	38	48·75	37·75	31	30·75	18·5	11·5	5·75	2·25	1	·75	·75	—	—	—	300
16·5—17	·5	1	2·75	5·5	7	19·5	15·5	30	35·75	40·75	42·5	34·5	23·75	15·25	14·25	5·5	3·5	1·25	·75	·5	—	—	300
17—17·5	1	1·25	1·25	3	4·75	6·75	10·5	15·75	24	35·25	41·75	30·25	20·25	17·75	8·75	6·75	6·25	4·5	·75	1·5	—	—	242
17·5—18	—	—	·25	·25	1·5	2·25	3·75	7	11·25	21	22	16	18·25	15	11·75	9·25	6	1·75	·25	1	—	·5	149
18—18·5	—	—	·25	·25	—	1·25	1	3	4·5	8·25	11·5	10	10·5	9·5	5	3	4·75	1·25	—	—	—	·5	74·5
18·5—19	—	—	—	—	—	·75	·25	·5	1	2·25	3·25	2·75	2·75	4·75	1·5	1·75	1·25	1·75	—	—	—	—	24·5
19—19·5	—	—	—	—	—	·25	·75	·5	·25	1	·25	1·25	1·5	1·5	·5	·75	1·75	·75	—	—	—	—	11
19·5—20	—	—	—	—	—	—	·5	·5	—	·5	—	—	1	—	—	·25	·25	—	—	—	—	—	3
20—20·5	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
20·5—21	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	·5
Totals	2·5	8	12·5	22·5	35·5	81	97	134	162	179·5	173·5	142	108	83·5	53	30	25	12	2·5	3	—	1	1368

TABLE XLV.

Father's Forearm and Daughter's Span.

Father's Forearm.

Daughter's Span.	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	Totals
53—54	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	·5	1·5	—	—	—	—	—	—	—	—	—	—	—	2
55—56	—	—	·25	1·25	·25	·25	—	—	—	—	—	—	—	—	—	2
56—57	—	—	—	1·5	2·5	1	1	—	—	·25	·25	—	—	—	—	6·5
57—58	—	—	—	2	3·25	4·75	3·75	1·75	—	·75	·75	—	—	—	—	17
58—59	—	·25	3·5	8	10	15·5	9·5	3·25	2	·25	·25	—	—	—	—	52·5
59—60	·5	1·75	2·75	6·25	18	17·25	21	8·75	3·75	1·75	·25	·5	·5	—	—	83
60—61	—	1·75	2·75	8·75	21	29·25	30·75	18·25	10·75	2·5	1·25	·5	—	—	—	127·5
61—62	—	2	4·25	9·5	24·5	37·75	38·25	18·75	17·75	3·25	1·5	1·5	·5	—	—	159·5
62—63	—	·25	4·25	8	21	34·5	45·5	34·5	24	8·5	3·5	·5	—	—	—	184·5
63—64	—	·5	·75	4·25	20·5	38·75	50·25	34·5	19·5	8	3·25	1·25	1	1	1	184·5
64—65	—	·75	1	4	17·25	24	43	37·75	25·75	8	3	2·5	2·25	·25	—	169·5
65—66	—	·25	·25	2	9·5	20·75	32·5	33·5	16·75	12·75	9·5	1·75	1·25	·25	—	141
66—67	—	·25	·25	2·75	6·75	11	19	18	16·5	10	2·5	·5	—	—	—	87·5
67—68	—	·25	·25	·25	2·25	3·25	14	19	17	9·5	3·25	·75	·25	·25	·25	70·5
68—69	—	—	—	·75	·75	1·75	7	7·75	10	9·75	4	1·5	·25	·25	·75	44·5
69—70	—	—	—	—	1	1·25	3·25	4	3·25	2·5	3·5	1·75	—	·5	1	22
70—71	—	—	—	—	—	—	1·5	3	1·75	1·5	1·25	—	—	—	—	9
71—72	—	—	—	—	—	—	·75	1·25	2·25	1·5	·25	—	—	—	—	6
72—73	—	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	·5
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
74—75	—	—	—	—	—	—	—	·25	·25	—	·5	—	—	—	—	1
75—76	—	—	—	—	—	—	—	·25	·25	—	·5	—	—	—	—	1
Totals	·5	8	21	61	158·5	241	321	244·5	171·5	81	39·5	13	6	2·5	3	1372

TABLE XLVI.

Mother's Stature and Son's Span.

Mother's Stature.

Son's Span.	52—53	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	Totals
58—59	—	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	·5
59—60	—	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	·5
60—61	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	·5
61—62	—	—	—	—	—	—	—	2·25	·25	·25	·25	—	—	—	—	—	—	—	—	3
62—63	—	—	—	—	—	—	·5	1	·5	·25	·25	1	—	—	—	·5	—	—	—	4
63—64	·5	·5	·5	·5	—	·5	1·5	4·75	·75	1	2	—	—	—	—	·5	—	—	—	13
64—65	—	—	·5	·5	—	1·25	2·25	3·5	4	4	3·75	5	1·75	—	1	—	—	—	—	27·5
65—66	—	—	·25	·25	3	3·25	2·5	5·75	11	13·25	7·5	8·25	2·5	·75	·5	·25	—	—	—	59
66—67	—	—	·25	·25	2·25	2·75	4·25	10·5	14·75	15·5	10·5	7·25	5·25	3·75	1	1·25	1	—	—	80·5
67—68	—	—	—	—	1·25	4·25	7·5	18·25	22	16·5	17	6·5	2	1·75	2·5	·5	—	—	—	100
68—69	—	—	—	—	·5	3·25	6·5	12·25	15·75	20·25	24	15·5	16·5	6·5	1·5	·5	—	—	—	123
69—70	—	—	—	—	—	2	6·75	10·25	25·5	20·75	27·75	19·25	15·75	5·25	1·5	2·25	·5	—	—	137·5
70—71	—	—	—	1	—	3·5	2·75	3·5	22·25	21·5	29·75	28	15·75	9·75	3·5	1	·75	—	—	143
71—72	—	—	—	—	—	·75	·75	5	11·5	20	19·25	16·75	16·5	8·75	5·5	1·75	2	1	—	109·5
72—73	—	—	—	—	—	·5	·5	2·75	8·25	18	19	13·75	12	9·75	5·5	2·75	·25	—	—	93
73—74	—	—	—	—	—	—	·25	3	4·25	9·25	12·5	10·75	10·25	14·25	7·75	1·75	1	—	—	75
74—75	—	—	—	—	—	—	—	1	1·5	4	7·25	11·75	6·25	7·5	2·75	·5	2	—	—	44·5
75—76	—	—	—	—	—	—	—	·25	1·75	3	2·75	4·75	5	2	3·5	1	·5	2	1	27·5
76—77	—	—	—	—	—	—	—	·25	·75	1	·5	2	2	2	—	·25	·25	1	—	10
77—78	—	—	—	—	—	—	—	—	—	·5	·5	1·5	·5	3·75	·75	·25	·25	—	—	8
78—79	—	—	—	—	—	—	—	—	—	1	—	·5	·5	1·25	·25	1	·5	—	1	6
79—80	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	·5	—	—	—	1
80—81	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	·5
81—82	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
Totals	·5	·5	1·5	2·5	7	22	36	84·5	145	170·5	185	152·5	112·5	77·5	38	17·5	9	4	2	1068

Son's Forearm.

Total	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—
3	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	—
4	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	—
5	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	—
6	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1	—
7	—	—	—	—	—	—	—	—	1	1	1	1	1	1	1	—
8	—	—	—	—	—	—	—	1	1	1	1	1	1	1	1	—
9	—	—	—	—	—	—	1	1	1	1	1	1	1	1	1	—
10	—	—	—	—	—	1	1	1	1	1	1	1	1	1	1	—
11	—	—	—	—	1	1	1	1	1	1	1	1	1	1	1	—
12	—	—	—	1	1	1	1	1	1	1	1	1	1	1	1	—
13	—	—	1	1	1	1	1	1	1	1	1	1	1	1	1	—
14	—	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
26	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
27	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
28	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
29	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
31	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
33	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
34	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
35	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
37	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
40	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
41	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
42	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
43	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
44	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
45	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
46	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
47	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
48	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
49	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
51	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
52	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
53	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
54	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
55	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
56	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
57	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
58	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
59	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
61	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
62	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
63	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
64	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
65	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
66	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
67	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
68	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
69	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
70	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
71	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
72	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
73	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
74	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
75	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
76	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
77	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
78	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
79	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—
Totals	1	1	1·5	2·5	7	22	36	84·5	145	170·5	185	152·5	112·5	77·5	38	17·5	9	4	2	1068

Son's Stature.

TABLE XLVII.

Mother's Span and Son's Stature.

Mother's Span.

Son's Stature.	53–54	54–55	55–56	56–57	57–58	58–59	59–60	60–61	61–62	62–63	63–64	64–65	65–66	66–67	67–68	68–69	69–70	70–71	Totals
59–60	—	—	—	—	—	—	·5	—	·25	·25	—	—	—	—	—	—	—	—	1
60–61	—	—	—	—	—	·25	·75	—	·25	·25	—	—	—	—	—	—	—	—	1·5
61–62	—	—	—	—	1	·25	·75	—	—	—	—	—	—	—	—	—	—	—	2
62–63	—	—	—	·5	·5	—	—	3	1	1·75	2	·25	—	—	—	—	—	—	9
63–64	—	—	1	·5	3	5·5	7·75	4·75	1·5	2·5	3·25	·75	—	—	—	—	—	—	30·5
64–65	1·25	·5	1·5	5·25	6·75	4	7·5	7	7·5	3·5	1·75	4·5	—	—	—	—	—	—	51
65–66	·25	·5	4·25	7·25	4·5	9·5	15	8	9·5	7·75	2·5	3·5	2·25	·25	—	—	—	—	75
66–67	—	—	4·25	8·75	6·75	11·5	15·5	14·25	18	13·75	11·25	6·75	2	1·75	1·5	·25	·25	—	116·5
67–68	—	—	2	1·75	7·75	11·5	19	26·25	31·75	23·5	15	13·25	7·25	2·5	1·75	1	·25	—	164·5
68–69	—	1	1	1	4·75	12·75	17·5	19·25	30·25	34·25	18·75	13·5	10·25	3·25	3·25	2·75	1	—	174·5
69–70	—	1	—	2	3	9	10	17·25	14·5	19·5	16·5	9·5	8·5	5·25	1·5	2·5	2·5	1	123·5
70–71	—	—	1	2·5	2·5	4·5	10·25	15·25	17·5	18	21	14·25	5·75	7	3	1·5	1·25	·25	125·5
71–72	—	—	—	—	—	2	3·75	8·25	11·5	13	13·75	9·5	7·75	4·5	3	2	·75	·25	80
72–73	—	—	—	—	—	2	2	5·5	9·25	6·25	9·25	3	3·75	4	1·5	1	1·25	·25	49
73–74	—	—	—	—	·5	1·75	1	1·5	6·75	6·5	6·25	3·75	2·5	2	·75	1·25	·25	1·25	36
74–75	—	—	—	—	—	—	·75	1·75	3	·25	1·75	2·5	3	·5	1	1·5	·5	—	16·5
75–76	—	—	—	—	—	—	—	—	·5	—	·5	1	1·5	·5	1·25	·25	·5	·5	6·5
76–77	—	—	—	—	—	—	—	—	—	—	1	1	1	—	—	—	—	·5	3·5
77–78	—	—	—	—	—	·5	—	—	—	—	—	—	—	·25	·25	—	—	—	1
78–79	—	—	—	—	—	·5	—	—	—	—	·5	·5	—	·25	·25	—	—	—	2
79–80	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	·5	—	—	—	1
Totals	1·5	3	15	29·5	41	75·5	112	132	163	151	125	87·5	55·5	32·5	19·5	14	8·5	4	1070

TABLE XLVIII.

Mother's Stature and Son's Forearm.

Mother's Stature.

Son's Forearm.	52–53	53–54	54–55	55–56	56–57	57–58	58–59	59–60	60–61	61–62	62–63	63–64	64–65	65–66	66–67	67–68	68–69	69–70	70–71	Totals
14–14·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
14·5–15	—	—	—	—	—	—	—	·5	·5	—	—	—	—	—	—	—	—	—	—	1
15–15·5	—	—	—	—	—	—	—	·5	·5	—	—	—	—	—	—	—	—	—	—	1
15·5–16	—	—	—	—	—	·5	—	·25	·25	—	·5	2	1	—	—	—	—	—	—	4·5
16–16·5	—	—	—	—	—	·5	—	2·75	·75	·75	·75	2·25	·25	—	—	—	—	—	—	8
16·5–17	·25	·25	·5	·5	1·5	1·75	3·25	7·25	8·75	4·75	3·75	1	1·5	—	·25	1	·25	—	—	36·5
17–17·5	·25	·25	·25	·25	3·25	2·25	9	11·75	14	14	14·75	6·75	3·75	1	·75	1·25	1·5	—	—	85
17·5–18	—	—	·5	·5	2·25	5·75	8·75	18	27	26	35	18·5	12·5	4·75	2·75	1	·25	—	—	163·5
18–18·5	—	—	·25	·25	—	5·25	8	19·75	38·75	42·5	45	36·5	21·5	12·25	5·5	1·75	·75	—	—	238
18·5–19	—	—	—	·5	—	2·5	4·5	11·5	28·75	39·5	40·25	31·25	21·25	13·5	8·5	3·25	·75	1	—	207
19–19·5	—	—	—	·5	—	1	2	6	15·75	23·75	22·75	27·25	24·25	20·25	8·5	4·5	1·5	·5	·5	159
19·5–20	—	—	—	—	—	—	·5	4·75	4	10·25	16·75	17·75	17·25	13·5	6	1·75	2	1·5	·5	96·5
20–20·5	—	—	—	—	—	—	·5	1·5	1·75	4·75	5	7·25	6·25	5·5	2·5	1·25	1·25	·5	—	38
20·5–21	—	—	—	—	—	—	—	—	1	1·75	·25	3·5	2	3	·5	·75	·75	·5	·5	14·5
21–21·5	—	—	—	—	—	—	—	—	·75	1·5	1·25	·5	—	1·75	·75	·5	—	—	·5	7·5
21·5–22	—	—	—	—	—	—	—	—	·5	1	—	—	1	—	—	1·5	—	—	—	4
Totals	·5	·5	1·5	2·5	7	19·5	36·5	84·5	143	170·5	186	154·5	112·5	75·5	37	18·5	9	4	2	1065

TABLE XLIX.

Mother's Forearm and Son's Stature.

Mother's Forearm.

Son's Stature.	13—13·5	13·5—14	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	Totals
59—60	—	—	—	·25	·25	·25	·25	—	—	—	—	—	—	1
60—61	—	—	—	·25	·5	·5	·25	—	—	—	—	—	—	1·5
61—62	—	—	—	·5	·75	·25	—	—	—	—	—	—	—	1·5
62—63	—	—	—	—	—	1·25	2·75	2·75	2·25	—	—	—	—	9
63—64	—	—	—	—	2·5	11·5	11·25	3·25	1	—	—	—	—	29·5
64—65	—	·25	·25	5	7·5	13·75	9·75	11·25	3·25	1·5	—	—	—	52·5
65—66	—	·25	2·5	5·5	12	18·75	16·75	10	5·5	2·75	·5	—	—	74·5
66—67	—	—	1·25	6·25	16	21·75	21	23	14·25	8	1·5	·5	·5	114
67—68	—	—	1·5	2·75	7·25	30·75	47·5	41·5	22·25	7·75	1·75	1·75	·75	165·5
68—69	—	—	1	2·5	10	27·75	51	38	22·5	12·5	7·25	2·5	·5	175·5
69—70	—	—	·75	3·5	2·25	16·25	31	30·5	24·25	9·25	3·75	1·25	·25	123
70—71	—	—	·25	1·75	4·25	16	30·5	30·75	25·75	8·75	5·75	1·25	·5	125·5
71—72	·5	·5	·5	·75	1·75	5	14·75	20·75	21·75	6·5	5	1·25	·5	79·5
72—73	—	—	—	·5	·5	3·25	12	11·25	7·75	7·75	4	1	—	48
73—74	—	—	—	1	1	2·75	6·25	12·25	5	3·75	4·25	·75	—	37
74—75	—	—	—	—	—	2·75	1·75	3·25	4	3·25	2·25	·5	·25	18
75—76	—	—	—	—	—	—	·75	·5	1·25	1·5	1·5	·75	·25	6·5
76—77	—	—	—	—	—	—	—	—	2·25	·75	·5	—	—	3·5
77—78	—	—	—	—	—	—	·5	—	·5	—	—	·25	·25	1·5
78—79	—	—	—	—	—	—	·5	—	·5	·5	—	·25	·25	2
79—80	—	—	—	—	—	—	—	—	—	—	—	·5	·5	1
Totals	·5	1	8	30·5	66·5	172·5	258·5	239	164	74·5	38	12·5	4·5	1070

TABLE L.

Mother's Span and Son's Forearm.

Mother's Span.

Son's Forearm.

	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	Totals
14—14·5													1						1
14·5—15																			1
15—15·5																			1
15·5—16				·25	·25		·5	·5	1	2	·5		·5						5·5
16—16·5				·75	1·25	1	2	1·5	·5	1·25	·75	1·25	1·75						9·5
16·5—17	·5		2·25	1	5·25	7·25	5	5·25	3·75	2·5	·75	1·25	2·5				·25	·25	37
17—17·5	·75	·25	3	4·25	8·5	9	17·5	12·5	10	8·5	3	4·75	3·75	1·75	1	·5	·25		86·5
17·5—18	·25	·5	5·5	10	7	16·25	22	23·5	24·25	20·5	17·75	8·5	8·25	7	2	·5	·25		163
18—18·5		·5	2·25	7·5	7·25	15	26·25	31·25	40·5	40·25	31	16·75	11	4·5	2·75	3·75	1·75	·25	236·5
18·5—19		·25	1	5	6·75	12·5	22·75	23·75	33·5	29·5	22·75	23·75	12	8·25	5	3·75	2	1·25	205·5
19—19·5		1		·75	2·5	7·5	11·25	16·5	21·25	21·75	27·75	16	8·75	6·5	3·5	3	3·75	1	159
19·5—20					1	2·75	2·25	14·5	12·5	14·5	12·75	9·25	4·5	2·25	2·25	1	·25		96
20—20·5						1·75	2	3·75	7	4·5	5·25	2·75	4·5	2·25	1	·5		·5	37·5
20·5—21					·25	·5	·5	·25	2·25	2·25	3·5	1·75	·5	·75	·25			·5	14·5
21—21·5					·25	·5	·5	·25	·5	1·5	·75	1·25	1	·25	1·25			·5	7·5
21·5—22						·75					1			1·25					4
						·5	—	—	—	—		—	—						
Totals	1·5	2·5	14·5	29·5	41	75·5	113·5	133·5	157	149	127·5	86	55·5	32·5	20	13·5	8·5	4	1065

TABLE LI.

Mother's Forearm and Son's Span.

Mother's Forearm.

Son's Span.	13—13·5	13·5—14	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	Totals
58—59	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	·5
59—60	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	·5
60—61	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	·5
61—62	—	—	—	·25	1	1·25	·5	—	—	—	—	—	—	—	3
62—63	—	—	—	1	·25	·25	1·75	·75	—	—	·25	·25	—	—	4·5
63—64	—	—	—	1·25	1·25	3·25	5·25	1·5	·5	·25	·25	—	—	—	13·5
64—65	—	·25	·75	5·25	3·75	5	4·75	4·75	1	·75	·25	—	—	—	26·5
65—66	·25	·5	1·5	3·25	6	14·75	14·5	9	4·5	2·25	1	·5	·5	—	58·5
66—67	·25	·25	1·25	2·75	8·5	20	18	13·5	8·75	3	·75	1	1	—	79
67—68	—	—	2	3·75	15	23·5	24·5	17·75	11	3	—	—	—	—	100·5
68—69	—	—	1	2·75	9	23	35·5	28·5	14·25	6·75	2·5	·25	—	—	123·5
69—70	—	—	·5	1·5	8·75	22·75	39·5	32·5	20·75	6·25	2·75	1·25	—	—	136·5
70—71	—	—	—	2	5·75	21·5	37	38·25	24·75	9·5	2·5	·25	—	—	141·5
71—72	—	—	—	3·25	2·5	11·5	25·5	27	21·75	13·25	5	1·25	·5	—	111·5
72—73	—	—	—	1	2·75	12·25	24·5	23	14·75	6·5	3·75	1	1	·5	91
73—74	—	—	·5	·75	·75	5·75	14·25	19	17·25	9·75	5·25	1·75	·5	—	75·5
74—75	—	—	—	·25	·25	3·5	8	11	11	4·75	3·75	1·5	·5	—	44·5
75—76	—	—	·25	·5	·25	1	2·5	7	5·5	3·25	5	1·25	—	—	26·5
76—77	—	—	·25	·5	·25	·75	1	2	3·25	1·5	·5	—	—	—	10
77—78	—	—	—	·25	·25	·5	·5	—	2	1·75	1·25	—	—	—	6·5
78—79	—	—	—	—	—	—	1·25	2·25	1	·75	1·75	·5	—	—	7·5
79—80	—	—	—	—	—	—	·25	·25	·25	·25	—	·5	·5	—	2
80—81	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	·5
81—82	—	—	—	—	—	—	—	—	—	—	—	·5	·5	—	1
Totals	·5	1	8	30·5	66·5	171	259·5	238	162·5	74	36·5	11·5	5	·5	1065

TABLE LII.

Mother's Stature and Daughter's Span.

Mother's Stature.

Daughter's Span.	52—53	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	Totals
53—54	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	—	—	—	·5	1	—	—	—	·25	·25	—	—	—	—	—	2
55—56	—	—	—	—	·25	·25	—	1	—	—	—	—	·25	·25	—	—	—	—	—	2
56—57	—	—	—	—	·5	1	1·5	1·25	1·25	1	—	—	—	—	—	—	—	—	—	·6·5
57—58	—	—	—	—	1·25	1·75	1·25	2·25	5·25	2·75	2·5	—	—	—	—	—	—	—	—	17
58—59	—	—	—	2	—	·75	6	11·25	10	9	5	2·5	2·75	1·25	1·25	·25	—	—	—	52
59—60	·5	·5	—	—	3	5·75	7·5	10	14·25	9·25	16·25	8·5	2·75	5·5	3	·75	—	—	—	87·5
60—61	—	—	·25	·75	1·5	1·5	9·25	18·5	19·5	26·5	18·5	17·5	6	4·5	2·25	1·25	·75	—	—	128·5
61—62	·5	—	·25	·75	1	1	7·5	18·5	20	27·75	26·25	26	17·5	7·25	1·75	·75	·75	—	—	157·5
62—63	·5	—	—	—	1·25	4·25	7·5	17·75	30	32·75	35·75	22	19·5	11	2·25	—	—	—	—	184·5
63—64	—	—	—	—	·25	1·5	5·25	12·75	22·25	34·75	34·25	31·25	17·25	14·75	7·75	1·5	—	—	—	183·5
64—65	—	—	—	—	—	1	3·5	8	20·75	24·25	33·5	33·5	21·75	12·25	8	·5	1	—	—	168
65—66	—	—	—	—	—	2·25	1·5	5	11·5	20·25	26·75	27·25	18·5	12·75	10·5	5	·75	·5	—	142·5
66—67	—	—	—	—	—	1	·75	·75	6	9·5	15·75	18·5	15	8·25	6·75	4·25	1	·5	—	88
67—68	—	—	—	—	—	—	—	1	5	8·75	12·75	14·5	10	9·75	5	1·75	1	—	—	69·5
68—69	—	—	—	—	—	—	—	—	1·75	3·5	6·25	4·25	5·75	7·25	3·75	2·25	2	2·75	1	40·5
69—70	—	—	—	—	—	—	—	1	1	—	—	5	4·5	3·5	6·25	1·75	1·25	·25	—	24·5
70—71	—	—	—	—	—	—	—	—	—	—	—	1·75	3·75	1·5	—	·75	·25	1	—	9
71—72	—	—	—	—	—	—	—	—	—	—	1	·5	·5	1·5	1	·75	·25	—	·5	6
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	·5
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
74—75	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	·5	1
75—76	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	·5	1
Totals	1·5	·5	·5	3·5	9	22	51·5	110	169·5	210	234·5	214	146	101·5	59·5	21·5	9	5	3	1372

TABLE LIII.

Mother's Span and Daughter's Stature.

Mother's Span.

Daughter's Stature.	52—53	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	Totals
52—53	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
53—54	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55—56	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
56—57	—	—	—	—	—	—	1·5	·5	·75	·25	1	·25	·25	—	—	—	—	—	—	—	4·5
57—58	—	—	—	2·75	2·75	—	2	1	2·75	·25	·25	2	·75	—	—	—	—	—	—	—	14·5
58—59	—	—	—	1·25	2·75	2	3	2	2·5	·5	·25	·25	·25	·25	·25	·25	—	—	—	—	15·5
59—60	—	—	·25	·75	3	4·25	7	12	9	2·25	3·75	2·75	1·5	1·5	·25	·25	—	—	—	—	48·5
60—61	—	·75	·75	4·75	7	8·25	12·5	12·5	15·75	10	9	7·75	4·75	3·25	—	1	1	—	—	—	99
61—62	—	·75	1	3·75	7·25	4·25	9·75	21	22·75	22·25	19·25	11·25	10	7	1·25	1	—	—	—	—	142·5
62—63	·5	—	1·5	3·25	10	10·5	15	20·25	29·25	25·5	26	22·75	12·25	9	3·25	·5	·25	1·25	—	—	191
63—64	·5	1	—	1	2·75	9·25	14	38	36·75	26	26·75	19·5	18·25	10·25	2·5	1·5	1·25	1·25	·5	·5	211·5
64—65	—	—	—	·5	2·5	6	11·25	25·25	25·25	27·5	34·75	19·25	26	10·25	2·25	1·25	2·75	1·25	·5	·5	197
65—66	—	—	—	—	·25	2·25	4·5	13·5	15·25	23·5	32·5	24·5	19·75	10·25	7·5	3·25	1·5	2	—	—	160·5
66—67	—	—	·5	·5	2·25	2·5	5·25	8·5	14	21	20·25	19·75	14·25	15·75	8·25	4·25	2·5	1·5	·5	—	141·5
67—68	—	—	—	—	1	1·75	1	3·75	6·5	9	19	8·75	4·75	7·75	6·5	3	2	1·25	1	—	77
68—69	—	—	—	—	·5	1·5	·75	1·75	3	3	5·75	3·25	3·25	4·75	2·75	2	·75	—	1	—	34
69—70	—	—	—	—	—	—	—	·5	1·25	·75	2	1·5	3·5	2·5	1·75	1·5	1·25	1·25	·75	—	18·5
70—71	—	—	—	—	—	—	·25	·25	·25	·25	1	—	1·5	1	·75	2	1·25	·25	·25	—	9
71—72	—	—	—	—	—	—	·25	·25	—	—	—	1	—	—	·25	·25	·5	—	1	—	3·5
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73—74	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Totals	1	2·5	4	18·5	42	52·5	89	162	185	172	201·5	145·5	121	83·5	37·5	22	15	10	5·5	1	1371

TABLE LIV.

Mother's Stature and Daughter's Forearm.

Daughter's Forearm.	Mother's Stature.																		
	52—53	*53—54*	*54—55*	*55—56*	*56—57*	*57—58*	*58—59*	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	Totals
13·5—14	—	—	—	—	—	—	—	·5	—	—	—	·5	—	—	·5	—	—	—	—	1·5
14—14·5	—	—	—	—	—	—	1·25	1·25	—	·5	—	·5	—	—	1·5	—	—	—	—	5
14·5—15	—	—	—	—	·75	·75	2·75	5·25	2·5	1·25	1·5	1·75	·75	·75	—	—	—	—	—	18
15—15·5	—	—	·25	1·25	2·25	2·5	3·25	12·5	11·25	8·25	9·75	7·75	3	1·75	1·25	·25	·25	—	—	65·5
15·5—16	·5	·5	·25	1·5	2·25	4·75	10·75	23·25	32·25	29·25	27·25	19·75	11·25	5	3·25	1·25	·5	—	—	173·5
16—16·5	1	—	—	·5	2·5	7·5	14	26·75	44·25	59·5	58	37·5	24·25	14·25	8	2·25	1·25	—	—	301·5
16·5—17	—	—	—	·25	1	3	8·5	23·75	38·75	48	54·75	53·75	38·25	20·5	5·5	3·25	·75	—	—	300
17—17·5	—	—	—	—	·25	3	5·75	12·25	25	39·75	44·5	45·25	33·75	19	12	3·25	·75	—	—	244·5
17·5—18	—	—	—	—	—	—	3	3	12·25	13·75	26	27·5	19·5	22·25	13	4·5	2·5	·75	·5	148·5
18—18·5	—	—	—	—	—	—	·75	1·25	5	7	9·75	12·75	9	11·25	8·75	5·25	1·5	·75	1·5	74·5
18·5—19	—	—	—	—	—	—	—	·25	·75	·75	1·5	4	4·75	6·25	2·75	1·25	1·25	1	—	24·5
19—19·5	—	—	—	—	—	—	—	—	—	—	2	2·5	1	1·5	1·5	·25	·25	·5	1	10·5
19·5—20	—	—	—	—	—	—	—	—	—	—	—	2	—	—	·5	—	—	·5	—	3
20—20·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
20·5—21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	·5
Totals	1·5	·5	·5	3·5	9	21·5	50	110	172	208	235	215·5	145·5	102·5	58·5	21·5	9	5	3	1372

TABLE LV.

Mother's Forearm and Daughter's Stature.

Mother's Forearm.

Daughter's Stature.	13—13·5	13·5—14	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	Totals
52—53	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	·5
53—54	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55—56	—	—	—	—	·5	·5	—	—	—	—	—	—	—	—	1
56—57	—	—	—	.5	·5	·25	2	1·25	—	—	—	—	—	—	4·5
57—58	—	—	—	1	2·5	2·75	5·5	2·75	—	—	—	—	—	—	14·5
58—59	—	—	—	1·5	5	3·25	2·25	1·25	1·25	·5	—	—	—	—	15
59—60	—	—	1	3·25	4	10·75	14·25	7·75	5	1·5	·5	—	—	—	48
60—61	—	·25	1·25	5·75	10·75	26·25	19	18	12·5	4·75	1	—	—	—	99·5
61—62	—	·25	·25	3·5	12	36·5	32·25	36	12·5	5·25	2·25	1	·75	—	142·5
62—63	—	·25	1·25	7·75	22	30·75	49·75	44·25	23	7·75	3·5	1·25	·5	—	192
63—64	—	·25	1·25	6·5	11·25	42	63·5	38	32·25	10·75	4·25	1·5	1	—	212·5
64—65	—	—	1·5	2·75	9·25	27·75	52·5	47	37·75	14·25	6·5	2	·25	—	201·5
65—66	—	—	—	1·75	4·5	18·75	35·25	40	33·5	12·5	7·75	1·5	1	—	156·5
66—67	—	—	·5	2·25	5	16·75	25·5	40·25	29	13·75	6	1·5	—	—	140·5
67—68	·25	·25	·5	·5	2·5	6·5	13·75	16·5	14·5	10·5	5	2·75	2·25	·25	76
68—69	·25	·25	—	—	1·25	3·75	5	7·5	5·5	5·25	4	1·25	·5	·5	35
69—70	—	—	—	·5	·5	—	1·5	2·75	5·75	4·25	1·5	1	·5	·25	18·5
70—71	·25	·25	—	—	—	—	—	1·25	3	1·25	1·75	1·25	·5	—	9·5
71—72	·25	·25	—	—	—	—	—	·5	·5	·25	1·5	·5	·25	—	4
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73—74	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
Totals	1	2	7·5	38·5	91·5	226·5	322	305	217	92·5	45·5	15·5	7·5	1	1373

TABLE LVI.

Mother's Span and Daughter's Forearm.

Mother's Span.

Daughter's Forearm.	*52—53*	*53—54*	*54—55*	*55—56*	*56—57*	*57—58*	*58—59*	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	Totals
13·5—14	—	—	—	—	·25	·25	—	—	—	·25	·25	—	·25	·25	—	—	—	—	—	—	1·5
14—14·5	—	—	—	—	·25	·25	·5	·75	·5	·5	·5	·25	·25	1·25	—	—	—	—	—	—	5
14·5—15	—	—	—	·5	1·75	1·25	4·25	3·25	3	·75	1·5	·5	1·25	·25	·25	—	—	—	—	—	18·5
15—15·5	—	—	·25	3·25	7·5	5·75	9·75	10	7·5	4·75	5·5	4·5	2·25	2·25	1·25	·5	·5	—	·25	·25	66
15·5—16	—	—	·5	4	10·5	13	18·75	26·5	30·5	17·75	16	15·25	8·25	5·5	1	1	·5	—	·25	·25	169·5
16—16·5	1	·25	1·75	5·5	10·25	14·75	23·25	43·5	47	38·5	44·75	30·25	20·75	13·75	2·75	2·5	1	—	·25	·25	302
16·5—17	—	1·25	·75	2·75	5·75	7·25	17·25	37·75	39·25	48·75	47·75	34·5	30·25	14·75	5·75	1·75	1·25	1·75	·25	·25	299
17—17·5	—	1	·5	1	3·25	6	11	25	33·5	34·5	39·75	28·75	27·5	17·25	9	3	2·5	·5	—	—	244
17·5—18	—	—	·25	·5	1·5	1·75	4·5	9·75	14·5	18·25	27·25	19·5	12·5	15·75	8·75	6	3·5	4·25	1	—	149·5
18—18·5	—	—	—	—	—	·75	1·25	4	6·5	5·25	14·25	7·5	9·75	8	7·5	3·25	3·25	2·25	1	—	74·5
18·5—19	—	—	—	—	—	—	—	·5	1·75	1·75	1·75	2	5	2·75	1·75	3·25	1·25	1·25	—	—	23
19—19·5	—	—	—	—	—	—	·25	·25	—	1	1·5	2·25	1	1·25	—	·75	·75	—	1	—	10
19·5—20	—	—	—	—	—	—	·25	·25	—	·5	·25	·75	—	·5	—	—	—	—	·5	—	3
20—20·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
20·5—21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	·5
Totals	1	2·5	4	17·5	41	51	91	161·5	184	172·5	201	146	119	83·5	38	22	14·5	10	6	1	1367

TABLE LVII.

Mother's Forearm and Daughter's Span.

Mother's Forearm.

Daughter's Span.	13—13·5	13·5—14	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	Totals
53—54	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	·5
54—55	—	—	—	—	—	—	—	1·5	·5	—	—	—	—	—	2
55—56	—	—	—	·25	·25	—	·5	·75	·25	—	—	—	—	—	2
56—57	—	—	—	1	2·75	1	1·75	—	—	—	—	—	—	—	6·5
57—58	—	—	·75	1·25	2·5	6	2·5	1·75	·75	—	—	—	—	—	15·5
58—59	—	·25	1·25	4·75	7·5	13	14	5·75	3·5	1·75	·75	—	—	—	52·5
59—60	—	·25	1·5	3·5	11·25	16·25	20·75	13	14	5·25	·75	·25	·25	—	87
60—61	·5	·5	·5	6·5	14·25	29·75	30	26·75	12·25	5·5	2·5	·75	·25	—	130
61—62	—	·25	1·25	7.25	10	32	40·5	38·5	15·5	8	3·5	·5	·25	—	157·5
62—63	—	·25	·75	5	15·75	37	50·5	39	24·5	7	3	·75	·5	—	184
63—64	—	—	—	3·25	10·75	27·75	53·25	43·25	29·75	9·5	2·5	·25	·25	—	180·5
64—65	·25	·25	·75	2·25	7·75	27·25	40·75	34·75	33·5	12·5	6·25	·75	·5	—	167·5
65—66	·25	·25	·75	1·75	5·75	18·25	29	42	23·75	10·25	7·75	2·25	·75	·25	143
66—67	—	—	—	·25	1·75	6·5	17	29·25	15·5	11·25	4	1·25	1	·25	88
67—68	—	—	—	—	1·25	7	11·5	16·75	18·75	10	3·5	·5	·25	—	69·5
68—69	—	—	—	—	—	2·75	4·5	9·75	12	5·25	5·75	2·5	1	—	43·5
69—70	—	—	—	·5	·5	1·25	1·75	2·75	7·5	3·25	1·75	2·25	·5	—	22
70—71	—	—	—	—	—	·25	·25	·25	2·75	1·75	2	1	1·25	·5	10
71—72	—	—	—	—	—	—	—	1·5	1	·75	·5	·75	·5	—	5
72—73	—	—	—	—	—	—	—	—	—	—	—	·25	·25	—	·5
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
74—75	—	—	—	—	—	—	—	—	·5	—	·5	—	—	—	1
75—76	—	—	—	—	—	—	—	—	·5	—	·5	—	—	—	1
Totals	1	2	7·5	37·5	92	226	318·5	307·5	217	92	45·5	14	7·5	1	1369

TABLE LVIII.

Brother's Stature.

Elder Brother.

Younger Brother.	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	Totals
60—61	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	·5
61—62	—	—	—	—	1·5	—	—	—	—	—	—	—	—	—	—	—	—	1·5
62—63	—	—	—	2	—	—	—	—	—	1·5	—	—	—	—	—	—	—	3·5
63—64	1	—	1·25	1·25	—	1·25	·25	—	—	·5	—	—	—	—	—	—	—	5·5
64—65	—	1	1·25	3·75	3·75	3	1·75	—	—	—	—	—	—	—	—	—	—	14·5
65—66	—	1	·25	·75	4	4	1·25	·25	1	—	—	—	—	—	—	—	—	12·5
66—67	·5	1·5	5·25	4·25	6·25	7·5	6	2·25	2·75	1·25	1	—	—	—	—	—	—	38·5
67—68	·5	—	1	5	2·25	9·5	10·75	6·5	5	2·25	1·75	—	—	—	—	—	—	44·5
68—69	—	1·5	2·5	3	7	12·25	9·25	6·5	11·5	5·75	1·25	2	—	—	—	—	—	62·5
69—70	·25	·25	1·5	·5	·75	4·5	7·25	6·25	6·5	4·25	1·5	2·75	·25	—	—	—	—	36·5
70—71	·25	·75	·5	1	3	6·5	12·75	5·5	3·25	6	4·25	2·5	1·25	—	—	—	—	47·5
71—72	—	—	—	1·5	1	1	3·25	3	7·75	3	1·75	·25	—	·25	·25	—	—	23
72—73	—	—	—	·5	—	·5	·75	4·5	1·75	3	2	1·5	—	·25	·25	—	—	15
73—74	—	—	—	·5	1·5	—	·75	2·75	1·5	—	·5	1·5	1·5	—	—	—	—	10·5
74—75	—	—	—	—	—	—	·25	·25	·5	1	·5	·5	1·25	·25	—	—	—	4·5
75—76	—	—	—	—	—	—	·25	·25	—	·5	—	1	·75	·25	—	—	—	3
76—77	—	—	—	—	—	—	—	—	—	1	—	1·5	—	—	—	—	—	2·5
77—78	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	·5
78—79	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	·5
79—80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	·5	1
Totals	2·5	6	13·5	24	31·5	50·5	55	38	41·5	30	14·5	13·5	5	1	·5	·5	·5	328

TABLE LIX.

Brothers' Span.

Elder Brother.

Younger Brother.	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	Totals
61—62	—	—	—	—	—	—	1	—	—	·25	·25	—	—	—	—	—	—	—	—	1·5
62—63	—	—	—	—	—	—	—	—	—	·25	·25	—	—	—	—	—	—	—	—	·5
63—64	1	—	—	—	—	·5	·5	—	—	—	—	—	—	—	—	—	—	—	—	2
64—65	—	—	1·25	·25	2·5	2·75	1·25	1	·5	—	·25	·25	—	—	—	—	—	—	—	10
65—66	—	—	·75	1·75	·75	6·5	·75	2·5	1	·5	·75	·25	—	—	—	—	—	—	—	15·5
66—67	—	—	·75	1·75	2·5	1·75	2·5	1	2·25	2	1·5	·75	1·25	—	—	—	—	—	—	18
67—68	—	1	·25	·75	1·25	3·75	4·25	1·5	2·5	2·75	1·25	3·5	1·25	—	—	—	—	—	—	24
68—69	—	—	—	1·75	2·25	1·25	3·5	4	7·75	8·25	7	4·5	1·75	—	—	—	—	—	—	42
69—70	—	—	·25	1	2	2·75	3·75	6·5	9·5	7·75	10·25	4	2·25	—	—	—	—	—	—	50
70—71	—	—	·25	·25	·25	1·25	1·75	5	7·5	5·75	4·25	3·75	4	2·5	—	—	—	—	—	36·5
71—72	—	—	—	—	·5	1	3	4·75	2·5	5·75	3·5	3·5	4·5	2	2·5	·75	·25	—	—	34·5
72—73	—	—	—	—	·5	1	1·75	1·25	6	4·25	5	3·25	2·75	1·25	1	·25	·25	—	—	28·5
73—74	—	—	—	—	—	—	·5	1	1	4	4·25	3·75	4·25	3·25	·5	—	1	—	—	23·5
74—75	—	—	—	—	—	—	1	·5	2·25	1·25	1·5	3·5	3	1·5	1	—	2	—	—	17·5
75—76	—	—	—	—	—	—	—	·5	2·25	·75	2·25	1·25	·5	·5	—	1	—	—	—	9
76—77	—	—	—	—	—	—	—	·5	—	·5	1·75	·5	·25	—	—	—	—	—	—	3·5
77—78	—	—	—	—	—	—	—	—	—	—	—	·25	·25	—	—	—	·75	·25	—	1·5
78—79	—	—	—	—	—	—	1	—	—	—	—	—	—	·5	2·5	—	·75	·25	—	5
79—80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80—81	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
81—82	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	·5	1
Totals	1	1	3·5	7·5	12·5	22·5	26·5	30	45	44	44	33	26	11·5	7·5	2	5	1	·5	324

TABLE LX.

Brothers' Forearm.

Elder Brother.

Younger Brother.	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	Totals
15·5—16	1	—	·5	—	—	—	—	—	—	—	—	—	—	1·5
16—16·5	—	—	1·75	·25	·25	·25	—	—	—	—	—	—	—	2·5
16·5—17	—	—	1·25	·75	3·25	·75	1·25	·25	—	—	—	—	—	7·5
17—17·5	—	·5	1	5·25	6·25	5·75	4	1·25	·5	—	—	—	—	24·5
17·5—18	·5	1	2	5	8·25	13·25	13	4·25	·5	·25	—	—	—	48
18—18·5	—	·5	2	7	15	20·75	13·5	8·75	3·5	2·25	1·25	·5	—	75
18·5—19	·25	·75	·5	3	8	15·5	15·75	12	7·25	3·5	1	—	—	67·5
19—19·5	·5	·5	—	1·25	3·25	8·25	10	15·75	8·75	1·5	·75	—	—	50·5
19·5—20	·25	·25	—	—	1·25	5·25	4·25	6	5·75	3·5	1	—	—	27·5
20—20·5	—	—	—	—	—	1·5	·5	1·5	3·5	·5	—	—	—	7·5
20·5—21	—	—	—	—	—	·25	1	1·75	1	1·5	—	—	—	5·5
21—21·5	—	—	—	—	·5	—	·25	·5	·25	·5	—	—	—	2
21·5—22	—	—	—	—	·5	—	—	—	—	·5	·5	·5	·5	2·5
Totals	2·5	3·5	9	22·5	46·5	71·5	63·5	52	31	14	4·5	1	·5	322

TABLE LXI.

Sisters' Stature.

Elder Sister.

Younger Sister.	*52—53*	*53—54*	*54—55*	*55—56*	*56—57*	*57—58*	*58—59*	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	*72—73*	*73—74*	Totals
55—56	—	—	—	—	—	—	—	—	—	·5	·5	—	—	—	—	—	—	—	—	—	—	—	1
56—57	—	—	—	—	—	·5	—	·5	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	1·5
57—58	—	—	—	—	—	1	1	·75	1·5	1·25	—	—	—	—	—	—	—	—	—	—	—	—	5·5
58—59	—	—	—	—	—	·5	—	·25	2·25	1	—	—	—	—	·5	—	—	—	—	—	—	—	4·5
59—60	—	—	—	—	—	1·75	1·75	·5	·5	3·75	2·25	3	·5	1	·5	·25	·25	—	—	—	—	—	16
60—61	—	—	—	—	·5	·75	1·25	2·75	4·75	2·5	6·5	3·25	5	1·5	1·25	·25	·25	—	—	—	—	—	30·5
61—62	—	—	—	—	·5	—	1	4	6·25	6·75	6	7	3·75	2	2·25	·5	—	—	—	—	—	—	40
62—63	—	—	—	—	·5	—	1	4·5	4·75	8·5	13·5	9·25	5·5	5·5	5·25	·75	1	—	—	—	—	—	60
63—64	·5	·5	—	—	—	—	·5	4	5	8·25	9	14·5	18	6·25	4·25	3·25	—	—	—	—	—	—	74
64—65	—	—	—	—	—	—	—	·75	1·75	10	11	11	13·75	4·75	6·5	2·5	1·75	·25	—	—	—	—	64
65—66	—	—	—	—	—	—	—	·25	2·75	7·25	5·5	8·5	16·25	9	9·75	2·75	4·25	1	·25	·5	—	—	68
66—67	—	—	—	—	—	—	—	1·25	1·5	2·75	6·75	5	8·75	9·75	6·5	4	4·25	3·75	·75	·5	—	—	55·5
67—68	—	—	—	—	—	—	—	—	·25	·25	·5	1·75	4·5	4	8·25	2·75	3·5	1·75	1·25	·25	—	1	30
68—69	—	—	—	—	—	—	—	—	—	—	·5	·75	2·5	·75	2·25	2·25	1·75	·25	·25	·25	—	—	11·5
69—70	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1·5	2·5	·5	·5	—	—	—	—	7
70—71	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·75	2	·5	—	—	—	—	3·5
71—72	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	·5
Totals	·5	·5	—	—	1·5	4·5	6·5	19·5	31·5	53	62	64	79·5	45·5	49	23	19·5	8	2·5	1·5	—	1	473

TABLE LXII.

Sisters' Span.

Elder Sister.

Younger Sister.	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	Totals
53—54	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	·5	1	·5	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	—	2·5
55—56	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
56—57	·25	·25	—	—	·5	1·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2·5
57—58	·25	·75	·5	·5	1	·5	—	—	·5	·5	—	—	—	—	—	—	—	—	—	—	—	4·5
58—59	1	—	·75	2	·75	1·5	2	2·5	—	1	—	—	—	—	—	—	—	—	—	—	—	11·5
59—60	—	—	1·25	1·75	3·75	4·25	2·75	3·25	3·5	1	3·75	·75	—	—	—	—	—	—	—	—	—	26
60—61	—	—	·5	5	5·75	5·25	8·5	5·5	3	5	2·75	1·25	—	—	—	—	—	—	—	—	—	42·5
61—62	—	—	1·25	4·5	3·5	6·5	7·75	6·75	8·5	5·25	4	·75	·25	—	1	—	—	—	—	—	—	50
62—63	—	—	·75	4·75	5·25	3·5	8·5	11	10·75	8·5	2·5	3	2	—	—	—	—	—	—	—	—	60·5
63—64	—	—	·5	1·5	2·75	6·5	10·5	8·25	9·75	10·25	3·5	8	2·5	·25	·25	·5	—	—	—	—	—	65
64—65	—	—	—	1·5	2·75	7	7·25	9	5·75	9·25	5	4·5	3·25	2	·25	·5	·5	—	—	—	—	58·5
65—66	—	—	—	·5	4·5	3	6·75	4·75	8	9	7·25	7	4·25	4	·75	·25	·5	—	—	—	—	60·5
66—67	—	—	—	—	2	1	3	2·5	3·75	4·5	3	1	1·5	1·25	1·75	·25	—	—	—	—	—	25·5
67—68	—	—	—	—	—	—	1	·75	1·75	5·25	7	8·25	4·75	2·25	1·5	—	—	—	—	·5	·5	33·5
68—69	—	—	—	—	—	—	—	·25	2·25	1	2·75	3	1·5	5	2·25	—	·5	·5	—	—	—	19
69—70	—	—	—	—	—	—	—	—	—	2·5	·5	2·5	1·5	1·75	1·5	·25	—	—	—	—	—	10·5
70—71	—	—	—	—	—	—	—	—	—	·5	·75	1·25	—	—	1·75	·25	1	—	—	—	—	5·5
71—72	—	—	—	—	—	—	—	—	—	—	·25	·75	—	1	·5	—	—	—	—	—	—	2·5
Totals	1·5	1	6	23	33	40·5	58	55·5	57·5	63·5	43	42	21·5	17·5	11·5	2	2·5	·5	—	·5	·5	481

TABLE LXIII.

Sisters' Forearm.

Elder Sister.

Younger Sister.	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	Totals
13·5—14	—	·25	·25	—	·5	—	·25	·25	—	—	—	—	—	1·5
14—14·5	—	·75	·75	—	·5	—	·25	·25	—	—	—	—	—	2·5
14·5—15	—	·75	·75	·25	1·25	·75	·25	—	—	—	·25	·25	—	4·5
15—15·5	—	1·25	3·75	6	4·5	3·25	·75	—	—	—	·25	·25	—	20
15·5—16	·5	1	6·5	14·5	13·75	11·75	6·5	·25	·25	—	—	—	—	55
16—16·5	—	·5	7·25	20·5	26·25	22	17·25	5·25	·5	—	·5	·5	—	100·5
16·5—17	—	1	4·75	11	25	29·5	24·25	7	2	—	—	—	—	104·5
17—17·5	—	·75	1·5	7	17·25	17	20·25	12·75	4	1	—	—	—	81·5
17·5—18	—	·25	·5	3·5	7·25	7·5	15·25	10·75	5·5	2·25	1	·25	—	54
18—18·5	—	—	—	1·25	4·75	5	5·75	7·25	5·5	3	1·75	·25	—	34·5
18·5—19	—	—	—	—	·5	1·25	1	3·5	2·75	·75	·25	—	—	10
19—19·5	—	—	—	—	—	—	·25	1·25	1	—	—	—	—	2·5
19·5—20	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20—20·5	—	—	—	—	—	—	—	—	—	—	·25	·5	·25	1
20·5—21	—	—	—	—	—	—	—	—	—	—	·25	·5	·25	1
Totals	·5	6·5	26	64	101·5	98	92	48·5	21·5	7	4·5	2·5	·5	473

TABLE LXIV.

Brother's Stature and Sister's Stature.

Brother's Stature.

Sister's Stature.	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	Totals
52—53	—	—	—	—	—	—	·25	·25	—	·5	—	—	—	—	—	—	—	—	—	—	—	1
53—54	—	—	—	—	—	—	·25	·25	—	·5	—	—	—	—	—	—	—	—	—	—	—	1
54—55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55—56	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
56—57	—	—	—	·25	1	·75	1·5	1	·5	—	—	—	—	—	—	—	—	—	—	—	—	5
57—58	—	—	—	1·25	3·75	2·5	3·25	4·25	·5	—	—	—	—	—	—	—	—	—	—	—	—	15·5
58—59	—	—	—	1	·5	3·25	4	5·25	3	—	—	—	—	—	—	—	—	—	—	—	—	17
59—60	—	—	—	3·25	5·5	8	6	7·75	11·5	5·25	2·75	2	·25	·25	—	—	—	—	—	—	—	52·5
60—61	—	—	1	1	5·75	11·25	16	19	16	12	5·75	3	3·25	1·5	1	—	—	—	—	—	—	96·5
61—62	·5	·5	—	2·25	6·5	10·25	15	21·5	31·5	24·25	9·75	11·5	8·25	1·25	4·5	·5	—	—	—	—	—	148
62—63	—	—	—	1	8·5	12·25	16	37·25	40	34·25	25·75	20·75	7·75	2	2	—	—	—	·25	·25	—	208
63—64	—	—	—	1	1·5	6·25	12·25	20·25	39·5	40·5	21·5	22·5	10·5	4·5	4·25	1	—	—	·25	·25	—	186
64—65	—	—	—	—	—	3·5	7	24·75	30·75	36·5	30	39·25	18·5	8	6·75	2·25	·25	1	·5	·5	—	209·5
65—66	—	—	—	—	1	4	2·5	13·25	23	34·75	23·25	27·75	16·25	10·5	7·25	1·5	·5	·5	—	—	—	166
66—67	—	—	—	·25	1·25	·5	3	4·25	11·5	21·75	25	26·25	19	20·5	7·5	3	1·25	1	—	—	—	146
67—68	—	—	—	·25	·25	—	1	·5	4·75	13	12·5	13	8	8·25	6·25	4·75	2	1·5	·5	·5	1	78
68—69	—	—	—	—	—	—	—	1·5	·5	3·25	5	7·25	7·25	3·25	4·5	1·75	2·75	—	—	—	—	37
69—70	—	—	—	—	—	—	—	—	—	·5	3·75	2·25	·5	3	·5	1·25	1·25	—	—	1	—	14
70—71	—	—	—	—	—	—	—	1	—	—	—	·25	1·75	—	1	2	1·5	·5	·75	·25	·5	9·5
71—72	—	—	—	—	—	—	—	—	—	—	—	1·25	1·75	—	1	·5	·5	·5	·25	·25	·5	6·5
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	2
Totals	·5	·5	1	11·5	36·5	63·5	88	162	213	227	165	177	103	63	47·5	18·5	10	6	2·5	3	2	1401

TABLE LXV.

Brother's Span and Sister's Span.

Brother's Span.

Sister's Span.	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	81—82	Totals
53—54	—	—	—	—	—	·5	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
54—55	—	—	—	—	—	·5	—	1·25	·25	·75	2·75	—	—	—	—	—	—	—	—	—	—	—	—	—	5·5
55—56	—	—	—	—	—	1	—	—	·25	·5	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	2
56—57	—	—	—	—	—	—	·25	1	1·75	2	·5	1	·5	—	—	—	—	—	—	—	—	—	—	—	7
57—58	—	—	—	—	·5	·5	1·25	2	3·5	1·5	2·5	2·75	—	1	—	—	—	—	—	—	—	—	—	—	15·5
58—59	—	—	—	1	·5	3·25	4·75	7	7·25	6·75	7·75	8·75	4·75	·75	·5	—	—	·5	·75	·25	—	—	—	—	54·5
59—60	—	—	—	—	·25	4	4·25	11	7·25	14	15·75	12·25	5·25	4	1·5	1·75	1·25	—	·25	·25	—	—	—	—	83
60—61	·25	·25	—	1·5	2	2·75	7·75	12	16·75	20·5	15·75	19·5	14·75	9·25	2·75	3·5	1·75	—	—	1	1	—	—	—	133
61—62	·25	·25	—	—	1·25	2·5	4	11·5	20	24·5	20·75	24·25	19	15	6·25	4·5	2·75	1·75	—	—	—	—	—	—	158·5
62—63	—	—	—	—	1·5	2	2·5	12	17·75	21·75	24·25	23·25	25·25	13·75	17·5	9·75	9	2·75	1	—	—	—	—	—	184
63—64	—	—	—	—	·5	—	3	5·75	10·75	14	17·75	23	32	23·75	20·25	13	6·5	2	1·75	2	—	—	—	—	176
64—65	—	—	—	—	—	·5	1·75	6	10·75	15	17·25	26·5	27·25	19·75	21·25	15·25	6	2	1·75	1	1	—	—	—	173
65—66	—	—	—	—	—	—	1	3·75	3·5	6·5	14	25·25	25·25	20·75	21·75	12·25	7	2·5	1	1	·5	—	—	—	146
66—67	—	—	—	—	—	—	1·5	·5	1·75	2·25	5·75	9·25	9·25	11·25	14·75	11·75	6·25	6	1·75	1·5	1·5	1	—	1	87
67—68	—	—	—	—	—	—	·5	—	·25	1·5	3·5	6	13·25	11·75	12·5	11·5	7·75	5·5	1	2·5	·75	·25	—	—	78·5
68—69	—	—	—	—	—	—	—	—	1	·5	1·5	5·25	3·25	7·5	8·75	4·25	5	5·75	1·75	1·5	·25	·25	—	—	46·5
69—70	—	—	—	—	—	—	—	—	—	—	—	·5	·75	2·5	2	3·25	3·75	4·25	·5	1	2	—	—	—	20·5
70—71	—	—	—	—	—	—	—	—	—	—	·5	·5	—	·75	1	·25	—	2	·5	1	1·5	·5	—	·5	9
71—72	—	—	—	—	—	—	—	—	—	—	—	1	—	·75	1·25	1·5	—	1	·5	—	·5	1	·5	·5	8·5
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	·75	·75	—	—	—	2
74—75	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	·75	·75	—	—	—	2
75—76	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Totals	·5	·5	—	2·5	6·5	17·5	32·5	74	103	132	150·5	189	180·5	142·5	132	92·5	57	37	12·5	14·5	10·5	3	·5	2	1393

TABLE LXVI.

Brother's Forearm and Sister's Forearm.

Brother's Forearm.

Sister's Forearm.	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	22·5—23	23—23·5	Totals
13·5—14	—	—	—	—	·5	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	1
14—14·5	1	—	—	—	·5	1	—	1·75	2	·75	·5	—	—	—	—	—	—	—	—	7·5
14·5—15	—	—	—	·25	·75	1·25	4·25	5·25	6·25	3	1	1·25	·25	—	—	—	—	—	—	23·5
15—15·5	—	·25	·25	·75	1·75	5·75	10·5	16·75	15·5	7·5	2	1	·5	·25	·75	—	—	—	—	63·5
15·5—16	—	·25	·25	·75	2·75	16·75	28·5	36·75	41·5	23·5	14·5	5·5	1·75	1	·75	—	—	—	—	174·5
16—16·5	—	—	—	·5	2	14·5	36·25	59·75	88	59·75	33·25	15·75	3·75	2·25	1	·25	—	—	—	317
16·5—17	—	—	—	·25	2·75	6·75	20	50·5	79	65·5	40·25	19·25	7·25	3·5	1·25	1·75	—	—	—	298
17—17·5	—	—	—	—	—	1	5·5	30·5	57	58·25	41	28·25	10·25	3·5	1·75	1·5	—	—	·5	239
17·5—18	—	—	—	—	—	1·5	4·25	8	23	31·5	38·25	30·25	10·25	4	3	2	—	—	1	157
18—18·5	—	—	—	·25	·25	·5	·75	2·25	8·75	18·75	23	16	6·75	3·75	2·25	·75	—	—	·5	84·5
18·5—19	—	—	—	·25	·25	—	—	·25	1·25	2·5	5·5	4	2·5	1·75	·5	1·75	—	—	—	20·5
19—19·5	—	—	—	—	—	—	—	·25	2	·75	1·25	2	2·5	1·75	1	—	—	—	—	11·5
19·5—20	—	—	—	—	—	—	—	—	·5	—	—	·75	1·75	·25	·25	—	—	—	—	3·5
Totals	1	·5	·5	3	11·5	49	110	212	325	272	200·5	124	47·5	22	12·5	8	—	—	2	1401

TABLE LXVII.

Brother's Stature and Brother's Span.

First Brother's Stature.

Second Brother's Span.	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	81—82	Totals
61—62																							
62—63																							
63—64				1																			
64—65																							
65—66																							
66—67							2																
67—68	·5	1·5						·5															
68—69																							
69—70																							
70—71																							
71—72																							
72—73																							
73—74																							
74—75																							
75—76																							
76—77																							
77—78																							
78—79																							
79—80																							
80—81																							
81—82																							
Totals	·5	1·5	6	11·5	28	34·5	70	95·5	117	74·5	87	53	29	23·5	9·5	4	3	1	1	1			651

63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	81—82	Totals
1																			2·5
																			2
																			6
	4·25	1·25																	18
	1·75	6·5	1																28·5
	6·5	5	6·5	6·5															42
1	4	2·25	6·5	8·25															50·5
2·75	2·25	3·5	8·25	17	16	8·75	1·25	2·5	1·75	4									73·5
2·25	2·25	8·5	8·25	13	17·5	11·5	9·75	7·5	6·25	5·5	4·75	2·5	2·25						95
1·25	4	2·5	7	9·5	16	9·75	10·5	13·5	7	6·25	1·75	3·25	1·75	1·5					80·5
2	1·5	1·75	6·25	10·5	18·25	7·5	13·5	5·25	6·75	3·5	3·25	2·5	1·5						79·5
·25	2·25	1·75	6·25	10	10·25	8	7	6·75	3·25	1·75	1·75	1·5							59·5
	1·5	1·25	3	5·25	7	10·5	9·5	5	5·75	1·75	1·75								49·5
		·5	1	1	4·75	5·5	6·25	3·5	1	2·25	·25								29
				1	1·75	2·5	3·25	3	1										15·5
		·5			·25	2·25	·75	2·25											5·5
							·25	·25											6·5
				·5	·5	3													6
						1													·5
																			·5
																			·5
																			—
																			1
63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	81—82	Totals

TABLE LXVIII.

Brother's Stature and Brother's Forearm.

First Brother's Stature.

Second Brother's Forearm.	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	*72—73*	*73—74*	*74—75*	*75—76*	*76—77*	*77—78*	*78—79*	*79—80*	Totals
15·5—16	—	—	—	—	·5	·5	1	1	1	—	—	—	—	—	—	—	—	—	—	—	4
16—16·5	—	—	·5	—	·25	·5	2·5	1·75	1	—	—	—	—	—	—	—	—	—	—	—	6·5
16·5—17	—	—	·5	2	·75	1·5	4	2	4·25	—	1	·5	·25	·25	—	—	—	—	—	—	17
17—17·5	—	—	—	1·75	5·5	6	8·75	9·25	9·25	1·75	2	1·25	·25	·75	—	—	—	—	—	—	46·5
17·5—18	·25	·75	·5	3·25	5·75	7·5	15	18·25	17·5	4·25	14·25	4	1·75	1·5	—	—	—	·5	·5	—	95·5
18—18·5	·25	·75	1·5	2·5	7·25	8·25	18·5	21	27	17	18·25	10	8	6	·5	·25	—	—	—	—	147
18·5—19	—	—	1·75	1·75	3·25	3·25	9·5	20	23·75	18·75	17·5	14·25	6·25	4·75	3·25	1	—	—	—	—	129
19—19·5	—	—	·75	·25	3	2·75	5	12	16·5	15	18·25	14·25	6	3·5	2	1	1·75	—	—	—	102
19·5—20	—	—	·5	—	·75	2·5	1·75	6·75	8·75	10·75	12·25	4·75	5·25	2·25	1·75	·75	·25	—	—	—	59
20—20·5	—	—	—	—	—	·75	1	2·5	3·75	3·75	2·5	2·5	1·25	1·25	·25	1	1	—	—	—	21·5
20·5—21	—	—	—	—	—	·5	—	—	1·75	2·75	·5	·5	1	2·25	·75	—	—	—	—	—	10
21—21·5	—	—	—	—	—	·5	—	·25	·75	—	—	—	—	1	—	—	—	—	—	·5	3
21·5—22	—	—	—	—	—	—	—	·25	·25	—	—	—	·5	·5	—	—	—	·5	·5	·5	3
Totals	·5	1·5	6	11·5	27	34·5	67	95	115·5	74	86·5	52	30·5	24	8·5	4	3	1	1	1	644

TABLE LXIX.

Brother's Span and Brother's Forearm.

First Brother's Span.

Second Brother's Forearm.

	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	81—82	Totals
15·5—16	—	—	—	1·5	2	·25	·25	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	4·5
16—16·5	·5	—	·25	1	1·75	·75	1·75	·25	·25	—	—	·25	·25	—	—	—	—	—	—	—	—	7
16·5—17	·5	—	1·25	3	1	·75	2·75	3·25	1·25	·5	·25	1·5	·5	—	—	·25	—	—	—	—	—	17
17—17·5	—	·5	·5	5	6·25	6·75	5	4·25	6·75	4·25	3·25	3·25	·5	·25	—	·25	·25	—	—	—	—	47
17·5—18	·5	·5	1·25	2·25	5·5	13·25	11	9·75	15	13·5	10·5	6·5	4·25	1	—	—	·5	1	—	—	—	96
18—18·5	·5	—	1	2	9·25	11	11	23·75	25·75	18·75	14·75	11·5	9·5	4	·75	—	—	—	—	—	—	146·5
18·5—19	·5	·5	·75	2·75	3·5	4·5	10·75	14·75	22·25	19·25	16·5	13	10·75	4·25	5·5	·5	1	—	—	—	—	131
19—19·5	—	—	·25	·25	1·25	3	4·75	11·5	10	14	17·5	15	10·75	7·25	2·25	1·75	2	1	—	—	—	102·5
19·5—20	—	—	·25	·25	—	·5	1·5	2·5	8	5·75	10	8·25	6·25	10·25	2	2	1	1	—	—	—	59·5
20—20·5	—	—	—	—	—	·25	1·25	·75	3	1·75	3·5	2·75	3	1·25	1	—	·5	2	—	—	—	21
20·5—21	—	—	—	—	·25	—	—	1	·75	1	1·75	—	1·75	·75	1·5	—	·5	·5	—	—	—	10
21—21·5	—	—	—	·25	·25	—	·5	—	·25	·25	—	—	—	—	·5	—	·5	—	—	—	·5	3
21·5—22	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	1	—	—	·5	·5	—	·5	3
Totals	2·5	1·5	5·5	18·5	31	41	51	72	93·5	79	78	62	47·5	29	16·5	5·5	6·5	6	·5	—	1	648

TABLE LXX.

Sister's Stature and Sister's Span.

First Sister's Stature.

Second Sister's Span.	*52—53*	*53—54*	*54—55*	*55—56*	*56—57*	*57—58*	*58—59*	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	*72—73*	*73—74*	Totals
53—54	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	—	—	·5
54—55	—	—	—	—	—	—	—	1	·5	1	—	—	—	—	—	—	—	—	—	—	—	—	2·5
55—56	—	—	—	—	—	·5	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1·5
56—57	—	—	—	—	—	·5	·5	·5	·75	·75	·5	—	—	—	—	—	—	—	—	—	—	—	3·5
57—58	—	—	—	—	·25	·75	1·5	1·25	1	3·25	·75	1·75	—	—	—	—	—	—	—	—	—	—	10·5
58—59	—	—	—	—	·5	3·5	1·75	3·25	4·25	4·25	2·75	8·25	2	2·75	1·75	—	—	—	—	—	—	—	35
59—60	—	—	—	—	·5	1·25	1·5	1·5	8	6	10·75	5·5	8	6	5	·5	·5	—	—	—	—	—	55
60—61	—	—	—	1	1·25	2	·75	4	11·25	10	15·25	14·5	10·5	6·75	3·75	1	·5	—	·5	·5	—	—	83·5
61—62	·25	·25	—	—	·5	·5	1·75	6·5	7·25	8·75	24·75	17·75	17·5	11·75	8	2	·5	—	—	—	—	—	108
62—63	·25	·25	—	—	—	1	1·75	5	7	15·25	16	23	23	9·25	9	2·75	—	—	—	—	—	—	113·5
63—64	—	—	—	—	—	—	1	5·25	8·25	13	15·25	21	21·5	12	13·5	5	3	·25	—	—	—	—	119
64—65	—	—	—	—	—	—	—	2·25	5·75	14	17·75	14·5	19·5	17·5	12·25	7	4	3·5	·5	·5	—	—	119
65—66	—	—	—	—	—	—	—	·5	4·5	10·25	8·25	16	14·75	12·75	15·75	7	8	1·25	—	·5	—	—	99·5
66—67	—	—	—	—	—	—	·5	2	3	4·5	5·5	8·75	9	11	8·75	9·75	4·25	1·25	1·25	·5	—	—	70
67—68	—	—	—	—	—	—	—	—	—	1·5	5	5·5	9	11·75	9	4·75	3·25	1·5	·25	—	—	1	52·5
68—69	—	—	—	—	—	—	—	—	1	—	·5	1·5	4·25	6	11·75	3·75	2	4·5	2·25	—	—	—	37·5
69—70	—	—	—	—	—	—	—	·5	·5	—	—	1	2·5	3	5	3·5	1·5	2·25	1·25	—	—	—	21
70—71	—	—	—	—	—	—	—	—	—	—	—	·5	·5	·5	2	2·5	1	·5	—	—	—	—	7·5
71—72	—	—	—	—	—	—	—	—	—	—	—	—	·5	·5	·5	1	1·5	1	—	—	—	—	5
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	·5
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
74—75	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	·5
75—76	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	—	—	—	·5
Totals	·5	·5	—	1	3	10	11	34·5	63	93	123	139·5	142·5	111·5	106	52	30	16	6	2	—	1	946

TABLE LXXI.

Sister's Stature and Sister's Forearm.

First Sister's Stature.

Second Sister's Forearm.	*52—53*	*53—54*	*54—55*	*55—56*	*56—57*	*57—58*	*58—59*	*59—60*	*60—61*	*61—62*	*62—63*	*63—64*	*64—65*	*65—66*	*66—67*	*67—68*	*68—69*	*69—70*	*70—71*	*71—72*	*72—73*	*73—74*	Totals
13·5—14	—	—	—	—	—	—	—	—	—	·5	—	·5	·25	·25	—	—	—	—	—	—	—	—	1·5
14—14·5	—	—	—	—	—	—	—	—	·5	1	—	·75	·5	·25	—	—	—	—	—	—	—	—	3
14·5—15	—	—	—	—	·5	1	1·25	2·25	—	1·5	1·25	·75	1·5	·5	—	—	—	—	·25	·25	—	—	11
15—15·5	·25	·25	—	—	·75	3·75	2·25	·75	6	7·5	5·25	10·25	3·5	2·75	1·25	·5	—	—	·25	·25	—	—	45·5
15·5—16	·25	·25	—	—	1·25	2·25	2	7·75	13·5	13·5	23·5	16·5	15	10·75	8·75	2·75	1	—	—	—	—	—	119
16—16·5	—	—	—	1	—	2	2·5	8·75	17·5	24·25	33·75	33·25	33·5	19	18·75	4·5	3·25	·5	·5	—	—	—	203
16·5—17	—	—	—	—	·5	1	1·75	7	15·25	22·75	26·25	35·5	37	20	17·75	9·5	3·75	2·75	·75	·5	—	—	202
17—17·5	—	—	—	—	—	—	1·25	6·75	6·75	18·75	18·75	21	26	30	23·75	11·5	6·25	3	·25	—	—	—	174
17·5—18	—	—	—	—	—	—	—	·75	3·5	3·75	9	11	13	21	21	8·75	6·25	3·75	1·25	—	—	·5	103·5
18—18·5	—	—	—	—	—	—	—	·5	-	·5	4·5	5·5	12	5·5	6	8·25	5·5	5·25	1·5	1	—	·5	56·5
18·5—19	—	—	—	—	—	—	—	—	-	—	·75	2·25	·5	2·25	5	3·75	·5	1·25	·75	—	—	—	17
19—19·5	—	—	—	—	—	—	—	—	—	—	—	·25	·25	1	2	1·25	1·75	—	·5	—	—	—	7
19·5—20	—	—	—	—	—	—	—	—	—	—	—	—	—	·25	·25	1	1	—	—	—	—	—	2·5
20—20·5	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	·25	·5	·25	—	—	—	—	1·5
20·5—21	—	—	—	—	—	—	—	—	—	—	—	—	·5	—	—	—	·25	·25	—	—	—	—	1
Totals	·5	·5	—	1	3	10	11	34·5	63	94	123	137·5	144	113·5	104·5	52	30	17	6	2	—	1	948

TABLE LXXII.

Sister's Span and Sister's Forearm.

First Sister's Span.

Second Sister's Forearm.	53—54	54—55	55—56	56—57	57—58	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	Totals
13·5—14	—	—	—	—	—	—	—	·25	·25	·5	—	—	·5	—	—	—	—	—	—	—	—	—	—	1·5
14—14·5	—	—	—	—	·5	·5	—	·25	·75	·5	—	—	·5	—	—	—	—	—	—	—	—	—	—	3
14·5—15	·25	1·25	·25	·5	·25	2	·5	1·5	1·25	1·25	·5	1·25	·25	—	—	—	—	—	—	—	—	—	—	11
15—15·5	·25	1·25	1·25	1	·25	4	5·25	6·25	7·5	8·25	4·5	4·25	1·5	—	·25	·25	—	—	—	—	—	—	—	46
15·5—16	—	—	—	·75	3·5	9·25	11	14·25	18	20·25	13	13·5	9·25	4	1·5	·75	—	—	—	—	—	—	—	119
16—16·5	—	—	—	1·25	3·5	9	15	21·5	26	29	29	24·75	17·75	17·5	5·25	2·5	—	—	—	—	—	—	—	202
16·5—17	—	—	—	—	2	3·5	12·25	18·75	29·25	25·5	29	30·75	20·75	15·25	7·5	2·75	3·75	1	·5	—	—	—	—	202·5
17—17·5	—	—	—	—	·5	4·75	7·75	13·5	17·25	18·75	25·5	21·25	24·75	11 25	12·5	9·5	6·25	·5	—	—	—	—	—	174
17·5—18	—	—	—	—	—	1	2·5	4·75	5	5·75	10·75	12·25	17·25	13	11·5	9·5	3·75	2·5	1·25	·25	—	·25	·25	101·5
18—18·5	—	—	—	—	—	—	·75	·5	2·75	2·75	6	6·75	5	6·25	8·25	6·25	6·25	2	2·25	·25	—	·25	·25	56·5
18·5—19	—	—	—	—	—	—	—	—	·5	1	1	3·25	1·25	2·25	·75	4·25	1·75	·25	·75	—	—	—	—	17
19—19·5	—	—	—	—	—	—	—	·5	—	—	·25	1·5	·25	—	1·25	2·5	·25	·25	·25	—	—	—	—	7
19·5—20	—	—	—	—	—	—	—	·5	—	—	—	·5	—	—	·75	·25	—	·5	—	—	—	—	—	2·5
20—20·5	—	—	—	—	—	—	—	—	—	—	—	—	·75	·25	—	—	—	·5	—	—	—	—	—	1·5
20·5—21	—	—	—	—	—	—	—	—	—	—	—	—	·75	·25	—	—	—	—	—	—	—	—	—	1
Totals	·5	2·5	1·5	3·5	10·5	34	55	82·5	108·5	113·5	119·5	120	100·5	70	49·5	38·5	22	7·5	5	·5	—	·5	·5	946

TABLE LXXIII.

Brother's Stature and Sister's Span.

Brother's Stature.

Sister's Span.	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	Totals
53—54	—	—	—	·5	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	1
54—55	—	—	—	·5	·5	·5	—	2·25	1·25	·5	—	—	—	—	—	—	—	—	—	—	—	5·5
55—56	—	—	—	—	·5	·5	—	·5	—	·5	—	—	—	—	—	—	—	—	—	—	—	2
56—57	—	—	—	—	2·25	1·5	1·25	3	—	—	1	—	—	—	—	—	—	—	—	—	—	9
57—58	—	—	—	—	1·25	2·75	1·25	3·25	4	1	1·5	·5	—	—	—	—	—	—	—	—	—	15·5
58—59	—	—	—	2·25	4	10·25	10	9·25	10·75	2·75	1·75	1·75	1·25	—	·5	—	—	—	—	—	—	54·5
59—60	—	—	1·5	1·5	3·75	4·75	13·25	18·25	16·25	8·5	6·25	4·25	2	·5	·75	—	—	—	—	—	—	81·5
60—61	·25	·75	·5	·25	8	12·75	16·75	16·25	23·25	21·75	10·75	13	3·75	1·25	3·25	·5	—	—	·5	·5	—	134
61—62	·25	·25	—	1·75	4	11·5	13·75	26·5	32·25	24·5	15·5	13·75	9·25	2·25	3	·5	—	—	—	—	—	159
62—63	—	—	—	3·5	4	5·75	10·25	31·5	30·5	29·5	23	20·5	9·25	7·5	6·75	2	—	·5	—	—	—	184·5
63—64	—	—	—	1·5	3	6	7·75	13·75	33·25	33·75	21·75	29·5	14·5	5·75	5·5	1	·5	1·5	—	—	—	179
64—65	—	—	·5	1·75	2·25	1·75	7·75	12·5	26·75	49·5	20	27	12·25	8	6	·5	—	—	·25	·25	—	177
65—66	—	—	—	—	1	1·5	3·75	11·75	19·75	23·75	25·75	26·75	16	8·75	5·5	2	·25	—	·25	·25	—	147
66—67	—	—	—	—	·5	1·5	2·25	3·5	11	12·75	11·75	10	12	9·25	5·75	3	2·25	—	·5	·5	1	87·5
67—68	—	—	—	—	·5	1	·5	2·75	3·25	10·5	12·25	16·75	11	9·5	5	3	1·5	1	—	—	—	78·5
68—69	—	—	—	—	—	·5	—	3·25	1·5	5·25	6·75	9·25	7·25	5·5	1·75	4	1·5	·75	·25	—	—	47·5
69—70	—	—	—	—	—	—	—	1·5	·5	1	4	5·25	2·25	2·75	1·25	1·5	2·5	·75	·25	—	—	23·5
70—71	—	—	—	—	—	—	—	—	—	1·5	3·5	·75	·25	2	—	—	—	—	·25	·25	·5	9
71—72	—	—	—	—	—	—	—	1	—	·5	1	1	1	1	·5	·5	1	—	·25	1·25	·5	9·5
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
74—75	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	·25	·75	—	—	—	2
75—76	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	·25	·75	—	—	—	2
Totals	·5	1	2·5	13·5	35·5	62·5	88·5	161	214·5	227·5	166·5	180	102	64	47·5	18·5	10	6	2·5	3	2	1409

TABLE LXXIV.

Brother's Span and Sister's Stature.

Brother's Span.

Sister's Stature.	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	81—82	Totals
52—53	—	—	—	—	—	—	—	—	—	·5	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	1
53—54	—	—	—	—	—	—	—	—	—	·5	—	—	—	·5	—	—	—	—	—	—	—	—	—	—	1
54—55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55—56	—	—	—	—	—	—	—	—	·5	1·5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
56—57	—	—	—	—	—	—	·25	1	1·5	·75	1·5	—	—	—	—	—	—	—	—	—	—	—	—	—	5
57—58	—	—	—	—	—	1	·25	1·75	3·25	3·75	3·25	·5	1·75	—	—	—	—	—	—	—	—	—	—	—	15·5
58—59	—	—	—	—	—	·5	—	2·75	2·5	4·75	2·25	3·75	1	—	—	—	—	—	—	—	—	—	—	—	17·5
59—60	—	—	—	·5	—	4·75	4·75	7	5·5	7·25	10·75	7·5	3·25	3·5	·25	·5	1	—	—	—	—	—	—	—	55·5
60—61	—	—	—	1	·5	3·25	6·25	12·5	11·25	12	15	15	9	4·75	1·25	1·25	1	·75	1·25	·5	—	—	—	—	96·5
61—62	·5	·5	—	·5	·5	4·5	4·25	12·25	15	22·5	19	17·5	15·75	14·25	9·25	6·5	5·25	·25	·25	1	—	—	—	—	149·5
62—63	—	—	—	·25	·25	2	5·5	12·5	21·5	28	29·25	32	21·25	17·75	19·75	10·5	4·5	·5	1	1	·5	—	—	—	208
63—64	—	—	—	·25	3·5	·5	3·75	7·75	16·25	18	20	28·5	31·5	19·25	17·75	7·5	6	2·5	·5	1	·5	—	—	—	185
64—65	—	—	—	—	1·25	·5	2·5	10·5	12·5	18·25	18·75	29·75	35	26·75	20·25	14·75	12·75	5	2·25	1·25	1	—	—	—	213
65—66	—	—	—	—	·5	1	2·75	3	6·5	9·75	14·5	24·25	22·75	23·5	18·75	16·75	7·5	6·5	2	2	·5	—	—	—	162·5
66—67	—	—	—	—	—	—	1·75	1	2·75	2·75	10	14·5	21·75	15·75	24	20	12·5	7·75	2·75	2·75	1·5	—	—	—	141·5
67—68	—	—	—	—	—	—	1	1·25	1·75	1·75	6·25	6·25	9·5	9·25	12·25	9·25	6·75	4·75	1·75	2·5	1·25	1	—	1	77·5
68—69	—	—	—	—	—	·25	·25	·25	1·25	·5	1·5	6·25	5	4·5	7	2	1·75	4·5	·25	·5	1·75	·5	—	—	38
69—70	—	—	—	—	—	·25	·25	—	—	—	·5	·75	1	3·25	3·5	—	1	2	·5	—	—	·5	·5	—	14
70—71	—	—	—	—	—	—	—	·25	·25	—	—	1	·5	·75	·25	—	—	2·5	1	—	1	·5	—	·5	8·5
71—72	—	—	—	—	—	—	—	·25	·25	—	—	—	—	·25	·75	1·5	—	1·5	—	—	1	·5	—	·5	6·5
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·5	·5	—	1	—	—	—	—	2
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Totals	·5	·5	—	2·5	6·5	18·5	33·5	74	102·5	132·5	152·5	187·5	179	144·5	135	90·5	59·5	39	13·5	13·5	9	3	·5	2	1400

TABLE LXXV.

Brother's Stature and Sister's Forearm.

Brother's Stature.

Sister's Forearm.	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	Totals
13·5—14	—	—	—	·5	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	1
14—14·5	—	—	—	·5	—	—	—	1·25	3·25	2	·25	·25	—	—	—	—	—	—	—	—	—	7·5
14·5—15	—	—	—	·5	2·75	3·25	3	4·25	3·25	2	1·5	1·25	·75	—	—	—	—	—	—	—	—	22·5
15—15·5	—	—	—	1	3·75	5·75	11·25	11·5	13·5	6·75	4·25	3·25	3	—	·5	—	—	—	—	—	—	64·5
15·5—16	·25	·5	·75	2·5	10	18	18·5	26·75	26	23·75	17	17	9	2·5	2·5	·5	—	—	—	—	—	175·5
16—16·5	·25	·5	·75	3	11	18	24·25	49	53·75	57·5	31·25	34·75	16·25	7·75	8·25	3·25	·5	—	·25	·25	—	320·5
16·5—17	—	—	—	3·25	5·25	10·75	18·25	34·25	61·25	48·25	33·5	38·5	16·75	8·75	12·25	1·5	—	2	·75	·75	1	297
17—17·5	—	—	—	1·75	1·75	5·75	7·75	18	35·75	44·75	37	41·5	19	12·25	8·25	2·75	1·5	·25	·5	·5	—	239
17·5—18	—	—	—	·25	1·25	1·5	1·5	7·25	12·5	27·75	29·5	22·5	20·5	17	10·25	4·75	2	1	—	—	—	159·5
18—18·5	—	—	—	·25	·75	1	1·75	4·25	6·5	11·5	11·75	14·5	12	9·5	4	3·25	3·25	1·25	·75	·25	·5	87
18·5—19	—	—	—	—	—	—	·25	·25	1	3·5	·75	6·25	2	1·25	1·25	1·75	1·75	—	·25	·75	·5	21·5
19—19·5	—	—	—	—	—	—	—	1·25	·25	·75	·25	1·75	1·5	·75	1·75	·75	1	1	—	·5	—	11·5
19·5—20	—	—	—	—	—	—	—	·25	·25	—	—	—	·75	·75	·5	—	—	·5	—	—	—	3
Totals	·5	1	1·5	13·5	36·5	64	86·5	158·5	217·5	228·5	167	181·5	101·5	60·5	49·5	18·5	10	6	2·5	3	2	1410

TABLE LXXVI.

Brother's Forearm and Sister's Stature.

Brother's Forearm.

Sister's Stature.	*14—14·5*	*14·5—15*	*15—15·5*	*15·5—16*	*16—16·5*	*16·5—17*	*17—17·5*	*17·5—18*	*18—18·5*	*18·5—19*	*19—19·5*	*19·5—20*	*20—20·5*	*20·5—21*	*21—21·5*	*21·5—22*	*22—22·5*	*22·5—23*	*23—23·5*	Totals
52—53	—	—	—	—	—	—	·25	·5	·25	—	—	—	—	—	—	—	—	—	—	1
53—54	—	—	—	—	—	—	·25	·5	·25	—	—	—	—	—	—	—	—	—	—	1
54—55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55—56	—	—	—	—	—	—	1·5	·5	—	—	—	—	—	—	—	—	—	—	—	2
56—57	—	—	—	—	—	·5	2	1	1·5	—	—	—	—	—	—	—	—	—	—	5
57—58	—	—	—	—	—	1·5	2·25	6·25	4	·75	·75	—	—	—	—	—	—	—	—	15·5
58—59	—	—	—	—	·5	1·5	3	4·5	4·5	2	1	·5	—	—	—	—	—	—	—	17·5
59—60	—	·25	·25	·5	2·25	7	8·5	10	15·75	6·75	3·25	·75	·25	—	—	—	—	—	—	55·5
60—61	—	·25	·25	—	1·5	10·75	15·25	20·5	21·75	16·25	4	2·75	·25	—	1	—	—	—	—	94·5
61—62	—	—	—	1	2·75	5·25	16·25	34	37·75	26·75	13·75	7·75	2·25	1	·5	—	—	—	—	149
62—63	—	—	—	·5	1·25	9·75	22·25	40·25	57	33·5	28·5	11	3·5	·5	·25	·25	—	—	—	208·5
63—64	—	—	—	1	2·25	5·5	13·5	28·25	50	37·75	24	14·5	4·5	2·5	1·5	·25	—	—	—	185·5
64—65	—	—	—	—	1	2	10·25	27·75	52·25	48·25	34·75	22·5	7	5·25	1·5	1·5	—	—	·5	214·5
65—66	1	—	—	—	—	2·25	6	17	38·25	36·75	27	21·5	9	2	·75	1	—	—	·5	163
66—67	—	—	—	—	—	1	5	13	25·25	33·75	32·75	20·5	6·75	2	2	1	—	—	—	143
67—68	—	—	—	—	—	·5	2·25	4	12	16·25	18·5	11	5	3·5	2	1·5	—	—	·5	77
68—69	—	—	—	—	—	1·25	1·25	2·5	4·5	7·75	6·25	4·75	3·5	2·25	1	1	—	—	·5	36·5
69—70	—	—	—	—	—	·25	·25	—	1·75	1·5	4·25	3·5	1·5	·5	·5	—	—	—	—	14
70—71	—	—	—	—	—	—	—	—	1·25	·75	1	1·75	1·5	1·25	·25	·75	—	—	—	8·5
71—72	—	—	—	—	—	—	—	—	—	·75	1·75	1·25	·5	·75	·75	·75	—	—	—	6·5
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73—74	—	—	—	—	—	—	—	—	—	—	—	—	1	·5	·5	—	—	—	—	2
Totals	1	·5	·5	3	11·5	49	110	210·5	328	269·5	201·5	124	46·5	22	12·5	8	—	—	2	1400

TABLE LXXVII.

Brother's Span and Sister's Forearm.

Brother's Span.

Sister's Forearm.	58—59	59—60	60—61	61—62	62—63	63—64	64—65	65—66	66—67	67—68	68—69	69—70	70—71	71—72	72—73	73—74	74—75	75—76	76—77	77—78	78—79	79—80	80—81	81—82	Totals
13·5—14	—	—	—	—	—	·5	—	·25	·25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
14—14·5	—	—	—	—	—	·5	1	·25	·25	2	2	—	·75	·25	—	·5	—	—	—	—	—	—	—	—	7·5
14·5—15	—	—	—	—	—	1·5	·5	3·25	2·25	4·5	3·5	3	1·25	·75	1	·5	—	—	—	—	—	—	—	—	22
15—15·5	—	—	—	—	—	2·5	2	8·5	7	10	10·25	11	4·75	6·25	1·25	—	—	·25	·5	·25	—	—	—	—	64·5
15·5—16	·25	·25	—	1·5	—	6·75	8·75	17·5	22	21·25	24·25	22·75	15·75	13·25	9·75	6·75	1·25	1	1·25	·75	—	—	—	—	175
16—16·5	·25	·25	—	·5	·75	4·75	12·5	19·75	31·5	38·25	41·5	44·5	43·75	29·25	22·5	14·75	10·25	2·75	·75	1	·5	—	—	—	320
16·5—17	—	—	—	·5	4·5	1·25	4	15	25	34	27·75	42	43	33	30·25	15·5	11	4	3	1·25	1	·5	—	1	297·5
17—17·5	—	—	—	—	1·25	·25	2·75	6·5	10	14·25	22·5	44·25	39·25	31·25	23·5	23·25	10·25	5	3·5	1·25	2	—	—	—	241
17·5—18	—	—	—	—	—	·5	1·5	1	2·5	4·5	13·25	14·75	22·5	18·5	22·5	18	19·5	7·5	2·25	5·25	2·75	·25	—	—	157
18—18·5	—	—	—	—	—	—	·5	1	1·25	2·5	5·5	6	9	12	16·25	10·25	6·25	7·25	1·5	1·75	3·5	·5	—	·5	85·5
18·5—19	—	—	—	—	—	—	—	·5	—	·25	1·25	·5	·75	2·75	3·5	2·5	1·5	4·25	·25	—	1·25	·5	·25	·5	20·5
19—19·5	—	—	—	—	—	—	—	·25	·25	·5	·75	1·25	·25	1	1·25	1	—	2	—	·75	1·75	·25	·25	—	11·5
19·5—20	—	—	—	—	—	—	—	·25	·25	·5	—	—	—	·25	·75	—	—	—	—	·75	·25	—	—	—	3
Totals	·5	·5	—	2·5	6·5	18·5	33·5	74	102·5	132·5	152·5	190	181	148·5	132·5	93	60	34	13	13	13	2	·5	2	1406

TABLE LXXVIII.

Brother's Forearm and Sister's Span.

Brother's Forearm.

Sister's Span.	14—14·5	14·5—15	15—15·5	15·5—16	16—16·5	16·5—17	17—17·5	17·5—18	18—18·5	18·5—19	19—19·5	19·5—20	20—20·5	20·5—21	21—21·5	21·5—22	22—22·5	22·5—23	23—23·5	Totals
53—54	—	—	—	—	·5	—	—	—	·25	·25	—	—	—	—	—	—	—	—	—	1
54—55	—	—	—	—	·5	—	1·25	1·25	2·25	·25	—	—	—	—	—	—	—	—	—	5·5
55—56	—	—	—	—	—	1	·25	·75	—	—	—	—	—	—	—	—	—	—	—	2
56—57	—	—	—	—	—	·5	2·25	3·5	2·75	—	—	—	—	—	—	—	—	—	—	9
57—58	—	—	—	·25	·25	1·25	3·25	4	3·5	3	—	1	—	—	—	—	—	—	—	16·5
58—59	—	·5	·5	·5	1·75	5·75	9·75	10	12	6·5	3	·5	·25	—	·5	—	—	—	—	51·5
59—60	—	—	—	·75	1	11	9·25	17·25	22	11·5	6·25	3·25	1·25	—	·5	—	—	—	—	84
60—61	—	—	—	—	1·25	9·25	20·5	29·5	32	18·5	10·75	4	2	·75	·5	·5	—	—	—	129·5
61—62	—	—	—	·5	2·25	6·75	19·75	34·75	41	28·5	15·75	8·5	2·5	1·5	·25	—	—	—	—	162
62—63	—	—	—	·25	2·25	6·5	13·5	32·25	49·5	35·25	22·75	15	3·5	1	·75	—	—	—	—	182·5
63—64	—	—	—	·25	·75	·75	8·75	27·5	46·75	37·75	33·5	14	4·25	4	·25	—	—	—	—	178·5
64—65	—	—	—	·5	·5	2	8·5	25·25	46·75	41·5	24·5	13·75	6	2·75	2·75	·25	—	—	—	175
65—66	1	—	—	—	·25	2·25	5·5	14·25	34·5	36	26·75	19·25	5·25	·75	·5	·25	—	—	—	146·5
66—67	—	—	—	—	·25	1	3·25	6·25	12·5	20·75	15·25	12·75	6·75	2·75	·5	3·5	—	—	1	86·5
67—68	—	—	—	—	—	1	2·75	3·25	9·5	19·75	17·75	11·5	5·75	3	1·75	2	—	—	1	79
68—69	—	—	—	—	—	1	1	2·25	4·25	7·75	14·5	9·5	3·25	1·75	2·25	—	—	—	—	47·5
69—70	—	—	—	—	—	—	·5	·5	1	2	5·5	6·5	3·75	1·25	—	—	—	—	—	21
70—71	—	—	—	—	—	—	—	·5	1·5	·25	2	2·75	·5	·5	·25	·75	—	—	—	9
71—72	—	—	—	—	—	—	—	—	2	·5	1·75	1·25	·5	1	·75	·75	—	—	—	8·5
72—73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73—74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
74—75	—	—	—	—	—	—	—	—	—	—	·25	·25	·5	·5	·5	—	—	—	—	2
75—76	—	—	—	—	—	—	—	—	—	—	·25	·25	·5	·5	·5	—	—	—	—	2
Totals	1	·5	·5	3	11·5	50	110	213	324	270	200·5	124	46·5	22	12·5	8	—	—	2	1399

VARIATION IN "OPHIOCOMA NIGRA" (O. F. MÜLLER).

By D. C. McINTOSH, M.A., F.R.S.E.

For two months during the autumn of 1902 I was permitted to occupy the "Aberdeen University Table" at the West of Scotland Marine Biological Station at Millport. This privilege I owe to the Professor of Natural History at the University of Aberdeen, at whose suggestion the following piece of work was primarily undertaken as an exercise in connection with the B.Sc. examination in Zoology.

The main purpose of the present communication is to give the results of my examination of certain external features of the Brittle-star *Ophiocoma nigra*. My first observations were made on specimens dredged in a single haul from near the Tan Buoy between the Cumbraes, on September 2nd, at a depth of from five to seven fathoms, from gravelly ground well known to be frequented by brittle-stars. They were gathered promiscuously, and on being brought to the laboratory were at once placed in tanks through which flowed a constant stream of sea water. Although other things were noted, I merely give here the results of my attempt to find:

1. The most general shape of the disc.
2. The shape and size of the coloured patch (if any) on the disc.
3. The correlation between arm-length and disc-breadth.
4. The percentage of specimens with an abnormal number of rays.
5. The number of madreporic plates.

In order that all the above points might be investigated when the animals were newly killed, the method I adopted was as follows. Specimens were selected at random from one of the tanks and immediately placed in fresh water. I found that in this way they died in from three to three and three-quarter minutes, and could be handled without exhibiting the brittleness characteristic of them when

killed by immersion in a solution of formaline. Then each animal was examined and a note taken of

1. The shape of the disc.
2. The colour.
3. The breadth of the disc.
4. The length of the longest ray.
5. The number of rays.
6. The number and position of the madreporic plates.
7. Any unusual character.

At first I confined my observations to a thousand specimens whose discs were 10 mm. and upwards in breadth. As the results of this preliminary examination were interesting, I next endeavoured to determine whether they extended to specimens of all sizes, even the most minute obtainable.

Accordingly on the 27th of September the same ground near the Tan Buoy was again dredged, with the result that we gathered over two thousand specimens, which on being brought to the Station were killed by immersion in fresh water. They were then preserved in a fifty per cent. solution of alcohol for future examination: and I shall now proceed to give the results I have arrived at from my examination of these and the other thousand specimens.

1. *As to shape of disc.*

One of the specific characters of this species, according to Forbes*, and Jeffrey Bell†, is that the disc is round, but an examination of the accompanying table (Table I.) points rather to the disc being in general pentagonal.

TABLE I.

Showing the Number of Specimens with Circular or Pentagonal Disc.

	Circular disc as in Fig. 1	Pentagonal disc as in Fig. 2	Pentagonal disc as in Fig. 3	Percentage with Pentagonal disc	Percentage with Circular disc
T_1	248	658	94	75·2	24·8
T_2	160	781	59	84	16
T_3	124	800	76	87·6	12·4
Average of T_2 and T_3	142	790·5	67·5	85·8	14·2

For convenience, let T_1, T_2, and T_3 denote the first, second, and third thousands respectively. No trouble was experienced in classifying the shapes of disc, for there was scarcely a single specimen which did not readily fall into one of three groups, namely, distinctly circular as in Fig. 1, or distinctly pentagonal (*a*) with the rays at the angles of the pentagon, as in Fig. 2, or (*b*) with the rays from the

* *A History of British Starfishes* (London, 1841), by Edward Forbes, p. 50.

† *Catalogue of the British Echinoderms in the British Museum* (London, 1892), p. 129.

centre of the sides of the pentagon, as in Fig. 3. The last two columns of the table give the percentages of specimens with pentagonal and with circular discs, and it will be remarked that the numbers for T_1 are somewhat different from those for T_2 and T_3, which are as consistent with each other as might fairly be expected. But it must be remembered that the shape of the disc necessarily depends largely on the quantity of food and water in the stomach of the animal at any particular time, and that T_1 were examined immediately after being killed, whereas the others had been lying for some time in alcohol. Further, T_1 consisted of "adults" only; and further still, one effect of the alcohol used for T_2 and T_3 was to slightly shrivel up the outer coating of the disc and thus better reveal its natural shape. It is clear, then, that if these three thousand specimens taken at random be really typical of *Ophiocoma nigra*, (1) the shape of the disc is in general pentagonal, and (2) the disc tends to become circular in the more fully developed animals.

2. *As to colour-markings.*

There can be no doubt as to the prevailing colour of the specimens I handled: it is dark brown. Whatever colour-variation occurred consisted mainly in the disc having a central yellowish sand-coloured patch, and in the rays being occasionally of a lighter brown than the disc. Jeffrey Bell says the colour of this species is "black or dark brown, the arms lighter than the disc; sometimes lighter and sometimes spotted." Forbes says: "Müller's name* well applies to the usual colour of this Brittle-star: the disc and rays are commonly black, or brownish black; the ray-spines dusky white or bluish. Sometimes the disc is prettily variegated, and there is a variety of an orange colour not uncommon in the Irish Sea. Mr Goodsir and I found some specimens in Shetland, of a most beautiful, delicate rose colour." Gosse, who merely describes the single specimen he chanced to find, remarks† of the species that "its hues are said to be various."

Paying no attention to the shape of the disc, but noting only the shape of the coloured patch (if any), I attempted to tabulate the different shape of coloured patches—see Table II. If any colour-marking occurred at all it was found to be

TABLE II.

Showing Relative Size and Shape of Colour-Markings on Disc.

	A	*B*	*C*	*D*	*E*	*F*	*G*
T_1	238	116	145	159	103	135	104
T_2	265	114	170	172	100	78	101
T_3	220	125	191	120	130	105	109
Average percentage	24·1	11·8	16·9	15·0	11·1	10·6	10·5
			31·9		21·7		

* The name O. F. Müller uses for this species is *Asterias nigra*, while Edward Forbes calls it *Ophiocoma granulata*.

† *A Year at the Shore* (London, 1870), P. H. Gosse, p. 227.

almost invariably regular in shape, either circular or pentagonal, but it did not follow that a circular disc had a circular colour-patch and a pentagonal disc a pentagonal one.

The shape, but not the relative size, of the central coloured part of the disc is shown in Figures 4, 5, and 6. Column *A* gives the number of specimens which were entirely of one colour, that colour being as stated, nearly always dark brown or black. (All were viewed with aboral surface upwards.) There was very little colour-variation in the rays, although generally they were not so dark as the disc, but in 2·8 per cent. of T_1 the rays were ringed with grey or white at every fifth set of plates for about half the length of the ray, beginning at the tip. In column *B* are given the numbers of those whose disc had a small coloured patch, often a mere speck, nearly always circular (as in Fig. 4) and never occupying more than one-fourth of the whole disc. Column *C* gives the numbers in which the coloured part was greater than one-quarter, but less than one-half of the disc. 16·9 per cent. had this marking, which was nearly always pentagonal (as shown in Fig. 5), although a few had the patch circular. Column *D* gives the numbers with a coloured part greater than one-half, but less than three-fourths of the area of the disc. This was always pentagonal (Fig. 5), and was found in 15 per cent. of the specimens. The numbers in columns *E* and *F* are those in which the size of the coloured part of the disc was the same as that in columns *C* and *D* respectively, while the shape was the same as that represented in Fig. 6. It is noted in column *G* that in 10·5 per cent. of the specimens, at least three-fourths—sometimes almost the whole—of the disc was sandy-coloured, although the rays still retained their characteristic brown appearance. The shape of the colour-marking in this case was usually of the pentagonal form shown in Fig. 6, the part of the disc at the point where each ray leaves the disc being usually of the colour of the ray. The conclusion then is that as regards the disc and its colour-markings,

1. 24·1 per cent. were entirely of one colour.
2. 11·8 per cent. had a small circular (Fig. 4) coloured patch.
3. 31·9 per cent. had a medium pentagonal (Fig. 5) coloured patch.
4. 21·7 per cent. had a medium pentagonal (Fig. 6) coloured patch.
5. 10·5 per cent. had a large pentagonal (Fig. 6) coloured patch.

It is thus seen (1) that in over 75 per cent. of the specimens the disc had a coloured patch, (2) that the shape of this coloured patch seemed to vary with its size (being circular when small and pentagonal when large), and (3) that the shape of the patch, like the shape of the disc itself, was in general pentagonal.

3. *Correlation between Arm-length and Disc-breadth.*

To measure the width of the disc I used a pair of finely pointed dividers, care being taken in the operation that the points touched, but did not press against the opposite sides of the disc. When the disc was pentagonal in shape, one point of

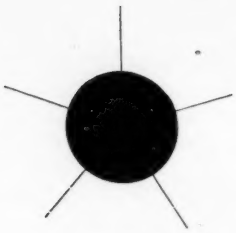


FIG. 1.

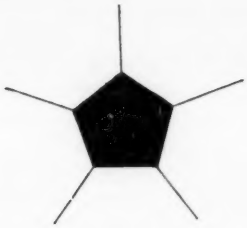


FIG. 2.

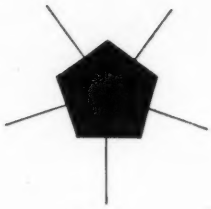


FIG. 3.

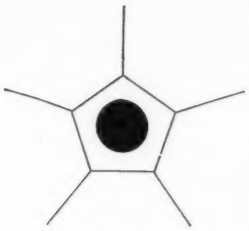


FIG. 4.

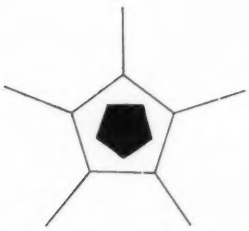


FIG. 5.

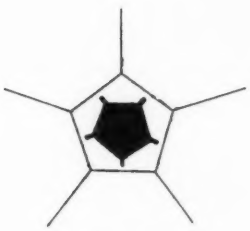


FIG. 6.

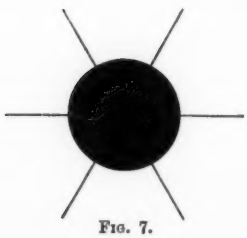


FIG. 7.

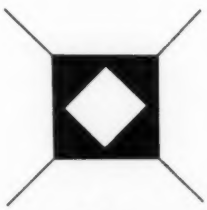


FIG. 8.

the dividers was placed at an angle of the pentagon and the other at the middle of the opposite side, whereas in circular discs the measurement was made along a diameter. I next measured the length of the rays, which in a perfect specimen taper gradually to a very fine thread. This measurement was made with the ventral surface upwards, for when a brittle-star is viewed dorsally each ray seems to come from a side of the disc, whereas when viewed ventrally it is seen that the rays begin nearer the mouth. Accordingly, the length of the ray was measured from the very tip of the ray to the innermost edge of the arm-plate nearest the mouth.

Forbes says* that "the rays taper gradually, and vary in their proportions as compared with the disc, but are generally from three to three and a half times as long as the disc is broad....The disc of this species generally measures half or three-fourths of an inch across. It sometimes grows much larger. Mr Ball has a specimen six inches in diameter; the disc half an inch broad: and I have one before me at present which measures eight inches across the rays." On the other hand, Jeffrey Bell says† that this species of ophiuroid is "moderately sized," and that the arms are "seven or eight times the radius of the disc," instancing five specimens whose discs varied from 4·5 to 11 millimetres and rays from 40 to 95 millimetres, the ray being therefore on the average about seven and a half times as long as the disc is broad.

Table III. gives the calculations on this correlation, the figures given being those only for the second thousand specimens examined. This table shows not only the various disc-breadths and arm-lengths, but each square gives the number of animals having a certain disc-breadth associated with a certain arm-length. From this table, by the methods and formulæ now familiar to readers of *Biometrika*, there have been deduced the following results:

Mean of disc-breadth	$= M_x = 10{\cdot}106$ mm.
Standard deviation of disc-breadth	$= \sigma_x = 2{\cdot}1449$ mm.
Mean of arm-length	$= M_y = 50{\cdot}656$ mm.
Standard deviation of arm-length	$= \sigma_y = 11{\cdot}2796$ mm.
Coefficient of correlation	$= r = 0{\cdot}9311$.

Knowing these results, we are now able to find the lines of regression. The line giving mean arm-length for known disc-breadth is found from the formula $y = \frac{r\sigma_y}{\sigma_x} x$ and is $y = 4{\cdot}8962x$. From the formula $x = \frac{r\sigma_x}{\sigma_y} y$ we find the line giving mean disc-breadth for known arm-length is $x = 0{\cdot}17705y$. The equation to the line of mean values of arm-lengths referred to the axes, arm-length = 0, disc-breadth = 0, is

$$(y - M_y) = \frac{r\sigma_y}{\sigma_x}(x - M_x),$$

which is

$$y = 4{\cdot}8962x + 1{\cdot}1747.$$

* *Op. cit.* Forbes, pp. 51, 52.

† *Op. cit.* Jeffrey Bell, p. 129.

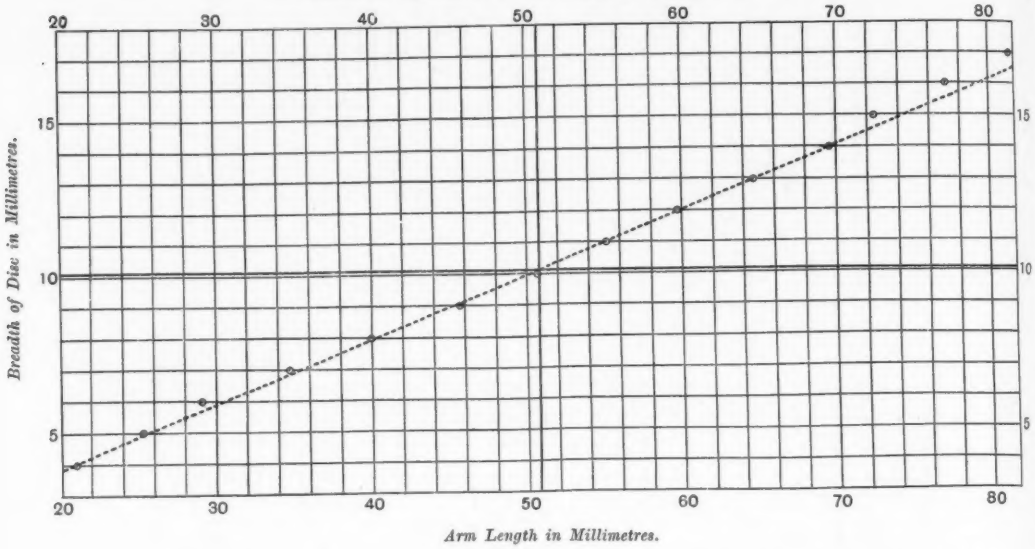
TABLE III.

Disc Breadth in Millimetres.

Arm Length in Millimetres.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals
20	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2
21	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2
22	2	1	—	—	—	—	—	—	—	—	—	—	—	—	3
23	—	3	—	—	—	—	—	—	—	—	—	—	—	—	3
24	—	3	—	—	—	—	—	—	—	—	—	—	—	—	3
25	—	3	1	—	—	—	—	—	—	—	—	—	—	—	4
26	—	3	4	—	—	—	—	—	—	—	—	—	—	—	7
27	—	1	1	—	—	—	—	—	—	—	—	—	—	—	2
28	—	2	8	3	—	—	—	—	—	—	—	—	—	—	13
29	—	—	3	1	—	—	—	—	—	—	—	—	—	—	4
30	—	1	2	—	—	—	—	—	—	—	—	—	—	—	3
31	—	—	3	6	—	—	—	—	—	—	—	—	—	—	9
32	—	—	6	5	—	—	—	—	—	—	—	—	—	—	11
33	—	—	3	9	—	—	—	—	—	—	—	—	—	—	12
34	—	—	2	10	4	—	—	—	—	—	—	—	—	—	16
35	—	—	—	2	3	—	—	—	—	—	—	—	—	—	5
36	—	—	—	5	8	—	—	—	—	—	—	—	—	—	13
37	—	—	—	3	10	4	—	—	—	—	—	—	—	—	17
38	—	—	1	7	16	5	—	—	—	—	—	—	—	—	29
39	—	—	—	3	9	2	—	—	—	—	—	—	—	—	14
40	—	—	—	2	12	4	—	—	—	—	—	—	—	—	18
41	—	—	—	—	7	6	1	—	—	—	—	—	—	—	14
42	—	—	—	3	17	6	—	—	—	—	—	—	—	—	26
43	—	—	—	—	11	11	—	—	—	—	—	—	—	—	22
44	—	—	—	—	2	13	5	—	—	—	—	—	—	—	20
45	—	—	—	—	4	11	11	—	—	—	—	—	—	—	26
46	—	—	—	—	4	12	5	2	—	—	—	—	—	—	23
47	—	—	—	—	1	14	11	4	1	—	—	—	—	—	31
48	—	—	—	—	1	20	34	8	1	—	—	—	—	—	64
49	—	—	—	—	—	11	8	2	—	—	—	—	—	—	21
50	—	—	—	—	—	4	17	10	1	—	—	—	—	—	32
51	—	—	—	—	—	5	23	13	6	1	—	—	—	—	48
52	—	—	—	—	—	5	19	6	2	—	—	—	—	—	32
53	—	—	—	—	—	3	21	17	2	—	—	—	—	—	43
54	—	—	—	—	—	1	11	20	9	—	—	—	—	—	41
55	—	—	—	—	—	—	8	10	10	—	—	—	—	—	28
56	—	—	—	—	—	—	8	18	4	1	—	—	—	—	31
57	—	—	—	—	—	—	5	14	9	3	—	—	—	—	31
58	—	—	—	—	—	—	2	14	11	4	1	—	—	—	32
59	—	—	—	—	—	—	3	8	11	4	—	—	—	—	26
60	—	—	—	—	—	—	1	8	12	6	1	—	—	—	28
61	—	—	—	—	—	—	1	5	16	4	1	—	—	—	27
62	—	—	—	—	—	—	1	5	13	6	1	1	—	—	27
63	—	—	—	—	—	—	—	2	3	10	—	—	—	—	15
64	—	—	—	—	—	—	—	4	3	5	—	—	—	—	12
65	—	—	—	—	—	—	—	1	3	7	1	—	—	—	12
66	—	—	—	—	—	—	—	1	9	5	—	—	—	—	15
67	—	—	—	—	—	—	—	2	5	9	1	—	—	—	17
68	—	—	—	—	—	—	—	—	4	9	5	1	—	—	19
69	—	—	—	—	—	—	—	—	4	1	—	1	—	—	6
70	—	—	—	—	—	—	—	—	—	6	3	1	—	—	10
71	—	—	—	—	—	—	—	—	1	2	3	—	—	—	6
72	—	—	—	—	—	—	—	—	—	2	1	—	—	—	3
73	—	—	—	—	—	—	—	—	—	2	2	—	—	—	4
74	—	—	—	—	—	—	—	—	1	2	3	1	—	—	7
75	—	—	—	—	—	—	—	—	—	1	1	2	—	—	4
76	—	—	—	—	—	—	—	—	—	—	1	1	—	—	2
77	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
78	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
79	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
80	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
81	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
82	—	—	—	—	—	—	—	—	—	—	—	1	—	1	2
Totals	6	17	34	59	109	137	195	174	141	90	26	9	1	2	1000

This line is shown in Diagram I., and is seen to represent very closely the observed facts.

DIAGRAM I. Regression of Arm Length on Breadth of Disc.



This result, that the arm-length is five times the width of the disc, is almost a mean between Jeffrey Bell's corresponding figure $7\frac{1}{2}$ and Forbes' 3 to $3\frac{1}{2}$. Their calculations were in all probability made from a few specimens, while mine are from one thousand. It must, however, be remembered that my measurements are from specimens which had been lying in alcohol for some weeks; but even although there may have been some contraction, it is not likely that the ratio of the breadth of disc to the length of ray would thereby be sensibly affected.

As it appears from Table III. that the entire range of variation of the disc-breadth is from 4 to 17 mm., it might readily be supposed that the size of the mesh of the net used in dredging had much to do with the fact that no specimens were found whose diameter measured less than 4 mm. Not much importance, however, can be attached to this objection, because nearly all the animals collected were brought to the surface clinging to blades of oarweed.

From the totals in Table III. we may form a polygon of frequencies. Diagram II. gives the curve which best fits this. The constants of this curve are:

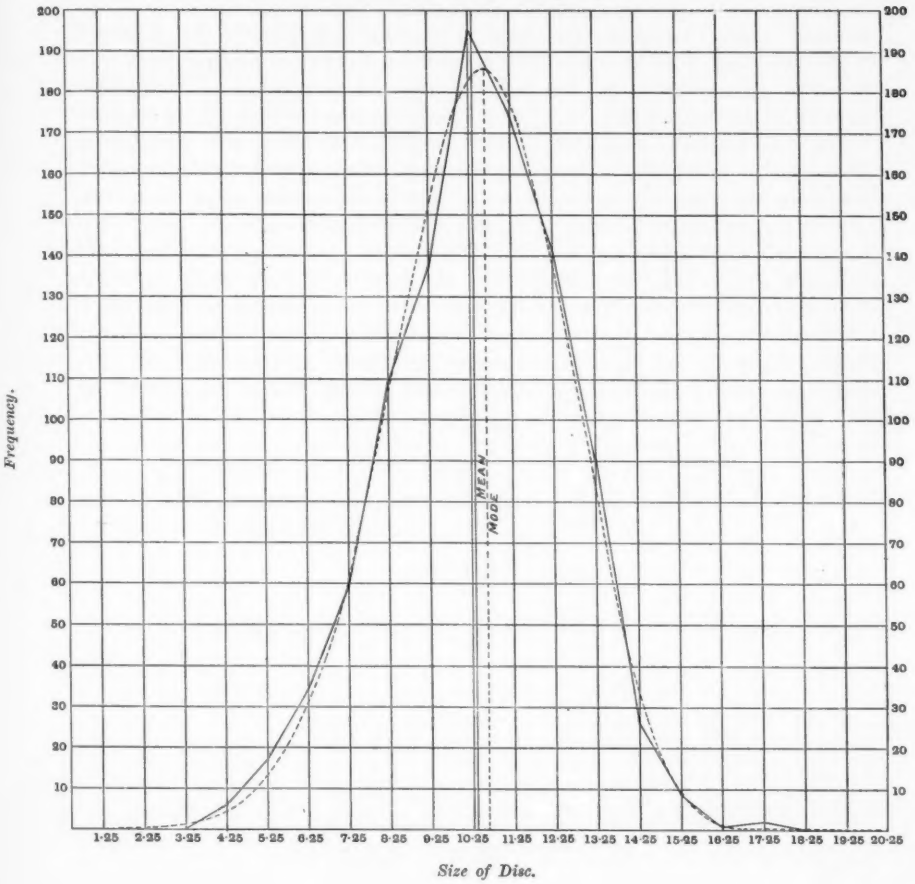
mean 10·357 mm.	$\mu_2 =$ 4·5222
mode 10·628 mm.	$\mu_3 = -2{\cdot}2366$
$\sigma =$ 2·1266 mm.	$\mu_4 =$ 60·2962

Equation to the curve:

$$y = 185{\cdot}57\left(1 - \frac{x}{9{\cdot}3264}\right)^{12{\cdot}6050} \times \left(1 + \frac{x}{20{\cdot}9913}\right)^{28{\cdot}3705}.$$

The origin of the curve is the mode, and the fit is a fairly good one.

DIAGRAM II. Polygon of Frequency.



4. *As to the number of rays.*

Forbes, in discussing the arrangement of the parts of Echinoderms* in general, says: "The reigning number is five. The name of 'five-fingers,' commonly applied by mariners to the star-fishes, is founded on a popular recognition of the number regnant. It has long been noticed. Among the problems proposed by that true-spirited but eccentric philosopher, Sir Thomas Browne, is one, 'Why among sea-stars, Nature chiefly delighteth in five points?' And in his *Garden of Cyrus* he observes: 'By the same number (five) doth Nature divide the circle of the sea-star.'" Any deviation from this characteristic number is, he continues, "Always either in consequence of the abortion of certain organs, or it is a *variation by representation*, that is to say, by the assumption of the regnant number of another class"; and "in ophiuroidea† the number *five* is absolute. Colour and proportions are the subject of variation." It is now well known, however, that *five* is not by any means absolute, even as regards the Ophiuroidea, for there are many species whose rays habitually number more than five. Mr Bateson indicates the same thing in his *Materials*. Jeffrey Bell says‡: "At a very early stage in the evolution of the Echinoderma, the adult tended to acquire a marked radial symmetry; but, at first, the number of rays was by no means constantly five; now the symmetry is so generally quinqueradial that wonder is nearly always expressed when the number five is diminished or increased." In my investigations I found in the first thousand five specimens with six rays. (See Table IV. and Fig 7.) In the second thousand I found four specimens with six

TABLE IV.

Showing Correlation of Parts of Six-Rayed Specimens.

		Shape of Disc	Breadth of Disc	Length of Ray	Madreporic Plates
First 1000	*1*	Hexagonal	14	60	1
	2	Hexagonal	13	56	1
	3	Hexagonal	13·5	68	1
	4	Circular	15	70	2 adjacent
	5	Circular	13·5	61	-
Second 1000	*1*	Hexagonal	11·5	50	3 adjacent
	2	Hexagonal	9	38	1
	3	Hexagonal	10	All damaged	1
	4	Circular	11	All damaged	1
	5§	Square	8·5	46	2 adjacent
Third 1000	*1*	Hexagonal	13·5	Damaged	1
	2	Hexagonal	13	Damaged	1
	3	Hexagonal	10	Damaged	1

* *A History of British Starfishes*, Introduction, pp. xv., xvi.

† *Op. cit.*, p. 20.

‡ *Catalogue of British Echinoderms*, Introductory Remarks.

§ Only four-rayed specimen found.

rays, and there was also a single specimen with four rays (see Fig. 8), perfect in every way. In the third thousand there were three specimens with six rays—all of which were, however, unfortunately considerably damaged. There is thus then less than one-half per cent. of deviation from the normal five rays. Are these deviations mentioned to be looked upon as* "abnormal variations," or merely as "very infrequent normal variations"?

5. *As to the number of madreporic plates.*

The madreporite, even in ophiuroids fresh from water or from alcohol, but especially in dry specimens, is very easily seen. Its position, shape, size, and colour readily assist one in finding it. Careful observation, even without a microscope, shows that it is perforated, but I do not think the perforations are nearly so numerous as seems to be generally supposed. Its colour, a delicate yellow, is distinctly lighter than that of the other plates in the angle between the rays. It is also larger and its heart-shape is characteristic. In my observations I found in all thirty-nine specimens which had two or more of the plates so like the madreporite that one could not tell the real madreporic plate. This peculiarity, I find, has been noted by Jeffrey Bell, who says that "in ophiuroids the stone-canal ends on one or several of the mouth shields." While it is true that there is normally but one madreporic plate, and it may be presumed there can be only one stone-canal, yet to all appearance more than one mouth-shield may be capable of performing the function of a madreporic plate. Table V. gives not only the number of specimens in the three thousand with more than one madreporic plate, but shows how the plates were situated in relation to each other. The relative percentages in the first, second, and third thousands are worthy of notice, there being on the average 0·13 specimens abnormal.

TABLE V.

Showing the Number and Relative Position of Madreporites.

Normal	Two adjacent	Two not adjacent	Three adjacent	Three not adjacent	Four	Five
988	4	6	—	—	1	1
987	4	4	—	5	—	—
986	8	2	1	2	1	—

* *The Grammar of Science*, p. 390.

TABLES OF POWERS OF NATURAL NUMBERS AND OF THE SUMS OF POWERS OF THE NATURAL NUMBERS FROM 1—100.

By W. PALIN ELDERTON, *Actuary.*

In many mathematical investigations it is of great advantage to have a table of the lower powers of the natural numbers. This is provided in a handy form, as far as the second and third powers of the first 10,000 numbers are concerned, in *Barlow's Tables* (E. and F. N. Spon, London, *Stereotype Edition*). But for many purposes we require to go beyond the cubes. Accordingly a table has been prepared of the first seven powers of the natural numbers from 1 to 250, and the first instalment of it 1–100 is given in Table I. below. Only after the work was completed did I discover that in the *first edition* of Barlow, such a table was provided. My numbers were checked against his and found to agree. It was still considered, however, desirable to publish Table I. below, because the first edition of Barlow published in 1814 is a most scarce work, and copies can rarely be procured even at much enhanced price, after several years' hunting in second-hand catalogues.

With regard to the sums of powers table (Table II.) Professor Pearson has already published such a table from 1 to 20 with powers up to the 7th*. My table ranges from 1 to 100 for the same powers. The final values of the sums of powers table were checked against the sums of the powers of the first 100 natural numbers as obtained by the usual finite difference method and this was also a check on the whole of the powers table. Miss E. M. Elderton helped me in some of the work, which was done by the use of Crelle's Tables checked by an arithmometer. As is well known the sums of the powers of natural numbers can be of great service in least square investigations†, and it is hoped that the present tables will be found useful, not only to biometricians but to others who need to represent observations by parabolic curves.

* *Biometrika*, Vol. II. p. 10.
† *Biometrika*, Vol. II. p. 9 *et seq.*

The following biometric illustrations are, of course, not exhaustive, but they may serve to indicate some cases wherein we have found a practical need for such tables as are now published.

Illustration I.

As example of the use of the Table I. of powers, we will find the coefficient of parental correlation between the sire and 2392 ♂ offspring in greyhounds. The categories selected were some black in coat colour and no black in coat colour. The following table resulted:

Sire.

Offspring.	Some Black	No Black	Totals
Some Black ...	1329	367	1696
No Black ...	316	380	696
Totals	1645	747	2392

The method of dealing with characters not quantitatively measurable was adopted* and by using Sheppard's tables† the following equation for the correlation coefficient r was found:

$$\phi(r) = \cdot 002{,}726r^7 + \cdot 057{,}149r^6 + \cdot 017{,}192r^5 + \cdot 083{,}578r^4 + \cdot 088{,}331r^3 + \cdot 134{,}717r^2 + r - \cdot 560{,}386 = 0 \quad \text{(i)}.$$

The derived function is:

$$\phi'(r) = \cdot 019{,}082r^6 + \cdot 342{,}894r^5 + \cdot 085{,}960r^4 + 334{,}312r^3 + \cdot 264{,}993r^2 + \cdot 269{,}434r + 1 \quad \text{(ii)}.$$

We can now find r by Newton's rule. We see from (i) that r is less than ·56 and the r^2 term being plus shows us that it must be less than ·52. Now take out the first seven powers of ·52 from Table I. and evaluate (i) by multiplication on an arithmometer, we find without clearing product figures from machine:

$$\phi(\cdot 52) = \cdot 016{,}384.$$

Similarly,

$$\phi'(\cdot 52) = 1 \cdot 278{,}466.$$

Hence

$$\phi(\cdot 52) / \phi'(\cdot 52) = \cdot 0128$$

and the next approximation to the root is

$$\cdot 52 - \cdot 0128 = \cdot 5072.$$

If we had kept powers of r up to the eighth instead of the seventh, the actual value of the root would be ·5070. We thus see that the above process gives the root true to three figures, amply sufficient for biometric purposes.

* *Phil. Trans.*, Vol. 195 A, pp. 1—47.

† *Biometrika*, Vol. II. p. 182 *et seq.*

Illustration II.

To show the use of the second table we will find, by the method of least squares, a parabola of the third order fitting the following expectations of life which have been taken from the recent experience of female annuitants collected by the Institute and Faculty of Actuaries (C. and E. Layton, 1899).

Age	*20*	*25*	*30*	*35*	*40*	*45*	*50*	*55*	*60*	*65*	*70*	*75*	*80*	*85*	*90*	*95*	*100*
Expectation of Life	45·3	41·1	38·0	34·3	31·2	27·9	24·2	20·6	17·0	13·5	10·5	7·8	5·6	4·1	3·0	2·5	2·0

I took age 15 as origin and calculated the products of the expectations into the first three powers of the distances from this age ÷ 5 continuously and checked the work by multiplying the expectation by the appropriate value of n^3 from Table I.

Then since the type-equation for a_r is

$$a_0 S_1^{17} x^r + a_1 S_1^{17} x^{r+1} + a_2 S_1^{17} x^{r+2} + a_3 S_1^{17} x^{r+3} = S_1^{17} N_x x^r$$

we can write down the equations for finding the a's immediately by using Table II. with $n = 17$ and we have

$$\begin{aligned}
17a_0 + \quad 153a_1 + \quad 1785a_2 + \quad 23409a_3 &= \quad 328{\cdot}6 \\
153a_0 + \quad 1785a_1 + \quad 23409a_2 + \quad 327369a_3 &= \quad 1782{\cdot}6 \\
1785a_0 + \quad 23409a_1 + \quad 327369a_2 + \quad 4767633a_3 &= \quad 14152{\cdot}8 \\
23409a_0 + 327369a_1 + 4767633a_2 + 71397705a_3 &= 139461{\cdot}0
\end{aligned}$$

The solution of these equations gives

$$\text{expectation of life} = 47{\cdot}46 - 2{\cdot}6013x - {\cdot}18435x^2 + {\cdot}01063x^3$$

and we obtain the following values agreeing very closely with the unadjusted expectations:

Age	*20*	*25*	*30*	*35*	*40*	*45*	*50*	*55*	*60*	*65*	*70*	*75*	*80*	*85*	*90*	*95*	*100*
Expectation	44·7	41·6	38·3	34·8	31·2	27·5	23·9	20·3	16·9	13·6	10·7	8·0	5·8	4·0	2·8	2·1	2·1

TABLE I.

Powers of Natural Numbers.

n	n^2	n^3	n^4	n^5	n^6	n^7	n
1	1	1	1	1	1	1	1
2	4	8	16	32	64	128	2
3	9	27	81	243	729	2187	3
4	16	64	256	1024	4096	16384	4
5	25	125	625	3125	15625	78125	5
6	36	216	1296	7776	46656	279936	6
7	49	343	2401	16807	117649	823543	7
8	64	512	4096	32768	262144	2097152	8
9	81	729	6561	59049	531441	4782969	9
10	100	1000	10000	100000	1000000	10000000	10
11	121	1331	14641	161051	1771561	19487171	11
12	144	1728	20736	248832	2985984	35831808	12
13	169	2197	28561	371293	4826809	62748517	13
14	196	2744	38416	537824	7529536	105413504	14
15	225	3375	50625	759375	11390625	170859375	15
16	256	4096	65536	1048576	16777216	268435456	16
17	289	4913	83521	1419857	24137569	410338673	17
18	324	5832	104976	1889568	34012224	612220032	18
19	361	6859	130321	2476099	47045881	893871739	19
20	400	8000	160000	3200000	64000000	1280000000	20
21	441	9261	194481	4084101	85766121	1801088541	21
22	484	10648	234256	5153632	113379904	2494357888	22
23	529	12167	279841	6436343	148035889	3404825447	23
24	576	13824	331776	7962624	191102976	4586471424	24
25	625	15625	390625	9765625	244140625	6103515625	25
26	676	17576	456976	11881376	308915776	8031810176	26
27	729	19683	531441	14348907	387420489	10460353203	27
28	784	21952	614656	17210368	481890304	13492928512	28
29	841	24389	707281	20511149	594823321	17249876309	29
30	900	27000	810000	24300000	729000000	21870000000	30
31	961	29791	923521	28629151	887503681	27512614111	31
32	1024	32768	1048576	33554432	1073741824	34359738368	32
33	1089	35937	1185921	39135393	1291467969	42618442977	33
34	1156	39304	1336336	45435424	1544804416	52523350144	34
35	1225	42875	1500625	52521875	1838265625	64339296875	35
36	1296	46656	1679616	60466176	2176782336	78364164096	36
37	1369	50653	1874161	69343957	2565726409	94931877133	37
38	1444	54872	2085136	79235168	3010936384	114415582592	38
39	1521	59319	2313441	90224199	3518743761	137231006679	39
40	1600	64000	2560000	102400000	4096000000	163840000000	40
41	1681	68921	2825761	115856201	4750104241	194754273881	41
42	1764	74088	3111696	130691232	5489031744	230539333248	42
43	1849	79507	3418801	147008443	6321363049	271818611107	43
44	1936	85184	3748096	164916224	7256313856	319277809664	44
45	2025	91125	4100625	184528125	8303765625	373669453125	45
46	2116	97336	4477456	205962976	9474296896	435817657216	46
47	2209	103823	4879681	229345007	10779215329	506623120463	47
48	2304	110592	5308416	254803968	12230590464	587068342272	48
49	2401	117649	5764801	282475249	13841287201	678223072849	49
50	2500	125000	6250000	312500000	15625000000	781250000000	50

TABLE I.—(*continued*).

Powers of Natural Numbers.

n	n^2	n^3	n^4	n^5	n^6	n^7	n
51	2601	132651	6765201	345025251	17596287801	897410677851	51
52	2704	140608	7311616	380204032	19770609664	1028071702528	52
53	2809	148877	7890481	418195493	22164361129	1174711139837	53
54	2916	157464	8503056	459165024	24794911296	1338925209984	54
55	3025	166375	9150625	503284375	27680640625	1522435234375	55
56	3136	175616	9834496	550731776	30840979456	1727094849536	56
57	3249	185193	10556001	601692057	34296447249	1954897493193	57
58	3364	195112	11316496	656356768	38068692544	2207984167552	58
59	3481	205379	12117361	714924299	42180533641	2488651484819	59
60	3600	216000	12960000	777600000	46656000000	2799360000000	60
61	3721	226981	13845841	844596301	51520374361	3142742836021	61
62	3844	238328	14776336	916132832	56800235584	3521614606208	62
63	3969	250047	15752961	992436543	62523502209	3938980639167	63
64	4096	262144	16777216	1073741824	68719476736	4398046511104	64
65	4225	274625	17850625	1160290625	75418890625	4902227890625	65
66	4356	287496	18974736	1252332576	82653950016	5455160701056	66
67	4489	300763	20151121	1350125107	90458382169	6060711605323	67
68	4624	314432	21381376	1453933568	98867482624	6722988818432	68
69	4761	328509	22667121	1564031349	107918163081	7446353252589	69
70	4900	343000	24010000	1680700000	117649000000	8235430000000	70
71	5041	357911	25411681	1804229351	128100283921	9095120158391	71
72	5184	373248	26873856	1934917632	139314069504	10030613004288	72
73	5329	389017	28398241	2073071593	151334226289	11047398519097	73
74	5476	405224	29986576	2219006624	164206490176	12151280273024	74
75	5625	421875	31640625	2373046875	177978515625	13348388671875	75
76	5776	438976	33362176	2535525376	192699928576	14645194571776	76
77	5929	456533	35153041	2706784157	208422380089	16048523266853	77
78	6084	474552	37015056	2887174368	225199600704	17565568854912	78
79	6241	493039	38950081	3077056399	243087455521	19203908986159	79
80	6400	512000	40960000	3276800000	262144000000	20971520000000	80
81	6561	531441	43046721	3486784401	282429536481	22876792454961	81
82	6724	551368	45212176	3707398432	304006671424	24928547056768	82
83	6889	571787	47458321	3939040643	326940373369	27136050989627	83
84	7056	592704	49787136	4182119424	351298031616	29509034655744	84
85	7225	614125	52200625	4437053125	377149515625	32057708828125	85
86	7396	636056	54700816	4704270176	404567235136	34792782221696	86
87	7569	658503	57289761	4984209207	433626201009	37725479487783	87
88	7744	681472	59969536	5277319168	464404086784	40867559636992	88
89	7921	704969	62742241	5584059449	496981290961	44231334895529	89
90	8100	729000	65610000	5904900000	531441000000	47829690000000	90
91	8281	753571	68574961	6240321451	567869252041	51676101935731	91
92	8464	778688	71639296	6590815232	606355001344	55784660123648	92
93	8649	804357	74805201	6956883693	646990183449	60170087060757	93
94	8836	830584	78074896	7339040224	689869781056	64847759419264	94
95	9025	857375	81450625	7737809375	735091890625	69833729609375	95
96	9216	884736	84934656	8153726976	782757789696	75144747810816	96
97	9409	912673	88529281	8587340257	832972004929	80798284478113	97
98	9604	941192	92236816	9039207968	885842380864	86812553324672	98
99	9801	970299	96059601	9509900499	941480149401	93206534790699	99
100	10000	1000000	100000000	10000000000	1000000000000	100000000000000	100

TABLE II.

Sums of Powers of Natural Numbers.

n	$S(n)$	$S(n^2)$	$S(n^3)$	$S(n^4)$	$S(n^5)$	$S(n^6)$	$S(n^7)$	n
1	1	1	1	1	1	1	1	1
2	3	5	9	17	33	65	129	2
3	6	14	36	98	276	794	2316	3
4	10	30	100	354	1300	4890	18700	4
5	15	55	225	979	4425	20515	96825	5
6	21	91	441	2275	12201	67171	376761	6
7	28	140	784	4676	29008	184820	1200304	7
8	36	204	1296	8772	61776	446964	3297456	8
9	45	285	2025	15333	120825	978405	8080425	9
10	55	385	3025	25333	220825	1978405	18080425	10
11	66	506	4356	39974	381876	3749966	37567596	11
12	78	650	6084	60710	630708	6735950	73399404	12
13	91	819	8281	89271	1002001	11562759	136147921	13
14	105	1015	11025	127687	1539825	19092295	241561425	14
15	120	1240	14400	178312	2299200	30482920	412420800	15
16	136	1496	18496	243848	3347776	47260136	680856256	16
17	153	1785	23409	327369	4767633	71397705	1091194929	17
18	171	2109	29241	432345	6657201	105409929	1703414961	18
19	190	2470	36100	562666	9133300	152455810	2597286700	19
20	210	2870	44100	722666	12333300	216455810	3877286700	20
21	231	3311	53361	917147	16417401	302221931	5678375241	21
22	253	3795	64009	1151403	21571033	415601835	8172733129	22
23	276	4324	76176	1431244	28007376	563637724	11577558576	23
24	300	4900	90000	1763020	35970000	754740700	16164030000	24
25	325	5525	105625	2153645	45735625	998881325	22267545625	25
26	351	6201	123201	2610621	57617001	1307797101	30299355801	26
27	378	6930	142884	3142062	71965908	1695217590	40759709004	27
28	406	7714	164836	3756718	89176276	2177107894	54252637516	28
29	435	8555	189225	4463999	109687425	2771931215	71502513825	29
30	465	9455	216225	5273999	133987425	3500931215	93372513825	30
31	496	10416	246016	6197520	162616576	4388434896	120885127936	31
32	528	11440	278784	7246096	196171008	5462176720	155244866304	32
33	561	12529	314721	8432017	135306401	6753644689	197863309281	33
34	595	13685	354025	9768353	180741825	8298449105	250386659425	34
35	630	14910	396900	11268978	333263700	10136714730	314725956300	35
36	666	16206	443556	12948594	393729876	12313497066	393090120396	36
37	703	17575	494209	14822755	463073833	14879223475	488021997529	37
38	741	19019	549081	16907891	542309001	17890159859	602437580121	38
39	780	20540	608400	19221332	632533200	21408903620	739668586800	39
40	820	22140	672400	21781332	734933200	25504903620	903508586800	40
41	861	23821	741321	24607093	850789401	30255007861	1098262860681	41
42	903	25585	815409	27718789	981480633	35744039605	1328802193929	42
43	946	27434	894916	31137590	1128489076	42065402654	1600620805036	43
44	990	29370	980100	34885686	1293405300	49321716510	1919898614700	44
45	1035	31395	1071225	38986311	1477933425	57625482135	2293568067825	45
46	1081	33511	1168561	43463767	1683896401	67099779031	2729385725041	46
47	1128	35720	1272384	48343448	1913241408	77878994360	3236008845504	47
48	1176	38024	1382976	53651864	2168045376	90109584824	3823077187776	48
49	1225	40425	1500625	59416665	2450520625	103950872025	4501300260625	49
50	1275	42925	1625625	65666665	2763020625	119575872025	5282550260625	50

TABLE II.—(*continued*).

Sums of Powers of Natural Numbers.

n	$S(n)$	$S(n^2)$	$S(n^3)$	$S(n^4)$	$S(n^5)$	$S(n^6)$	$S(n^7)$	n
51	1326	45526	1758276	72431866	3108045876	137172159826	6179960938476	*51*
52	1378	48230	1898884	79743482	3488249908	156942769490	7208032641004	*52*
53	1431	51039	2047761	87633963	3906445401	179107130619	8382743780841	*53*
54	1485	53955	2205225	96137019	4365610425	203902041915	9721668990825	*54*
55	1540	56980	2371600	105287644	4868894800	231582682540	11244104225200	*55*
56	1596	60116	2547216	115122140	5419626576	262423661996	12971199074736	*56*
57	1653	63365	2732409	125678141	6021318633	296720109245	14926096567929	*57*
58	1711	66729	2927521	136994637	6677675401	334788801789	17134080735481	*58*
59	1770	70210	3132900	149111998	7392599700	376969335430	19622732220300	*59*
60	1830	73810	3348900	162071998	8170199700	423625335430	22422092220300	*60*
61	1891	77531	3575881	175917839	9014796001	475145709791	25564835056321	*61*
62	1953	81375	3814209	190694175	9930928833	531945945375	29086449662529	*62*
63	2016	85344	4064256	206447136	10923365376	594469447584	33025430301696	*63*
64	2080	89440	4326400	223224352	11997107200	663188924320	37423476812800	*64*
65	2145	93665	4601025	241074977	13157397825	738607814945	42325704703425	*65*
66	2211	98021	4888521	260049713	14409730401	821261764961	47780865404481	*66*
67	2278	102510	5189284	280200834	15759855508	911720147130	53841577009804	*67*
68	2346	107134	5503716	301582210	17213789076	1010587629754	60564565828236	*68*
69	2415	111895	5832225	324249331	18777820425	1118505792835	68010919080825	*69*
70	2485	116795	6175225	348259331	20458520425	1236154792835	76246349080825	*70*
71	2556	121836	6533136	373671012	22262749776	1364255076756	85341469239216	*71*
72	2628	127020	6906384	400544868	24197667408	1503569146260	95372082243504	*72*
73	2701	132349	7295401	428943109	26270739001	1654903372549	106419480762601	*73*
74	2775	137825	7700625	458929685	28489745625	1819109862725	118570761035625	*74*
75	2850	143450	8122500	490570310	30862792500	1997088378350	131919149707500	*75*
76	2926	149226	8561476	523932486	33398317876	2189788306926	146564344279276	*76*
77	3003	155155	9018009	559085527	36105102033	2398210687015	162612867546129	*77*
78	3081	161239	9492561	596100583	38992276401	2623410287719	180178436401041	*78*
79	3160	167480	9985600	635050664	42069332800	2866497743240	199382345387200	*79*
80	3240	173880	10497600	676010664	45346132800	3128641743240	220353865387200	*80*
81	3321	180441	11029041	719057385	48832917201	3411071279721	243230657842161	*81*
82	3403	187165	11580409	764269561	52540315633	3715077951145	268159204898929	*82*
83	3486	194054	12152196	811727882	56479356276	4042018324514	295295255888556	*83*
84	3570	201110	12744900	861515018	60661475700	4393316356130	324804290544300	*84*
85	3655	208335	13359025	913715643	65098528825	4770465871755	356861999374225	*85*
86	3741	215731	13995081	968416459	69802799001	5175033106891	391654781594121	*86*
87	3828	223300	14653584	1025706220	74787008208	5608659307900	429380261081904	*87*
88	3916	231044	15335056	1085675756	80064327376	6073063394684	470247820718896	*88*
89	4005	238965	16040025	1148417997	85648386825	6570044685645	514479155614425	*89*
90	4095	247065	16769025	1214027997	91553286825	7101485685645	562308845614425	*90*
91	4186	255346	17522596	1282602958	97793608276	7669354937686	613984947550156	*91*
92	4278	263810	18301284	1354242254	104384423508	8275709939030	669769607673804	*92*
93	4371	272459	19105641	1429047455	111341307201	8922700122479	729939694734561	*93*
94	4465	281295	19936225	1507122351	118680347425	9612569903535	794787454153825	*94*
95	4560	290320	20793600	1588572976	126418156800	10347661794160	864621183763200	*95*
96	4656	299536	21678336	1673507632	134571883776	11130419583856	939765931574016	*96*
97	4753	308945	22591009	1762036913	143159224033	11963391588785	1020564216052129	*97*
98	4851	318549	23532201	1854273729	152198432001	12849233969649	1107376769376801	*98*
99	4950	328350	24502500	1950333330	161708332500	13790714119050	1200583304167500	*99*
100	5050	338350	25502500	2050333330	171708332500	14790714119050	1300583304167500	*100*

ASSORTATIVE MATING IN MAN.

A COOPERATIVE STUDY.

1. In considering the reproduction and progressive change of a population the part played by any form of differential mating within the population must be given its due weight. Darwin has given the name of sexual selection to the general conception of differential mating, but it seems necessary now to distinguish between various types of differential mating. As opposed to pure random mating within the population*, we have first *preferential mating*, in which male or female classes with certain values of a character find it less easy to mate than other classes with different values. Secondly we have *assortative mating* in which, while all classes of males and females find mates, certain classes of males appear to be attracted to certain classes of females. If the male class of a given character tends to mate with a female class with generally like character, we have a tendency to *homogamy*. Homogamy as one type of assortative mating is simply measured by the correlation between the two characters in the male and female of the pair. The influence of homogamy on the character of successive generations of a population may be very great indeed, and the whole range of effect from pure random matings to perfectly homogamous unions within a population is almost but not quite as important as the difference between self and cross fertilisation in plants. It has the distinctive features as compared with self-fertilisation, that (i) it may have any degree of intensity, (ii) it may be confined to special characters, and (iii) it is not complicated by any of the supposed harmful effects of in-breeding.

Theoretically the effect of assortative mating on offspring—especially its influence on the segregation of types—is very great, and it becomes of fundamental importance to ascertain how far it exists in actual populations, which are often *à priori* assumed to mate at random. The present cooperative study forms an attempt to measure the extent of assortative mating in man, by, not so much a single physical character, as the resulting effect of a complex of physical characters. It has been suggested that the duration of life is to some extent a rough measure of the general physical fitness to environment of an individual.

* By *random mating* we understand theoretically a state of affairs in which every type of male would be mated with every type of female, the random mating being with regard to one, two, three, many or all characters.

In the present study we endeavour to measure how far there is an assortative mating between husband and wife with regard to their durations of life, or rather with regard to the general physical characters on which this duration depends. It has been shewn in *Biometrika** that duration of life is an inherited character, and hence assortative mating in respect to this character may probably be looked upon as the mating of like stocks.

2. Our knowledge of assortative mating in man may be summed up as follows. It was first noted when dealing with Francis Galton's Family Records. K. Pearson here found a correlation of ·09 for stature† and ·10 for eye colour‡. In Pearson's more extensive series of Family Measurements, the following values were found§:

Assortative Mating in Man: 1000 *Cases.*

Stature	·2804
Span	·1989
Left Forearm	·1977
Mean Value . . .	·2257

Further, values between ·14 and ·20 were found for cross assortative mating, *e.g.* between stature in husband and forearm in wife.

Now this very sensible value of ·226 is either due to, (i) a real conscious or unconscious assortative mating in man, or (ii) to individual men and women mating within sub-races, local races or other limited classes.

Now the influence of (ii) can be more or less effectively determined in our present investigation by taking data within (*a*) a fairly limited class and (*b*) within limited districts. If any small local differences produce the observed result then we ought to find correlation sensibly as large as the assortative mating correlation, when we make random couples of men and women from the same locality and put several localities into the same table.

In collecting our material we were accordingly guided by the desire to get a fairly narrow district, and one if possible where there would be no unintentional selection of husbands and wives living approximately to the same age. By using pedigree tables we can avoid any selection of this kind, if both husband and wife are given, but in many pedigrees the ages of the men only are given. The records of the Society of Friends are an exception to this rule, and that Society forms a fairly homogeneous sub-class of the community: indeed so compact that attention has more than once been drawn to the differentiation of its actuarial constants from those of the community at large.

Data from pedigrees being limited owing to the too frequent absence of the dates of birth and death of the wives, we not unnaturally turned to the records provided by tombstones. In collecting such material, it is essential to work on

* Vol. I. p. 50. M. Beeton and K. Pearson: *On the Inheritance of the Duration of Life*, etc.

† *Phil. Trans.*, Vol. 187 A, p. 273.

‡ *Phil. Trans.*, Vol. 195 A, p. 113.

§ *Biometrika*, Vol. II., p. 373.

limited districts with a very stable population. For in a large urban population, such as is represented by the modern urban cemeteries, not only will a large mixture of local races due to immigration be found, but the population being very fluctuating, it is extremely likely that husband and wife will not be interred in the same cemetery, unless they die within a comparatively short period of each other, *i.e.* unless their ages at death are, in the modal cases of small difference of age, much alike. In most rural districts on the other hand with a stable population, there is a very strong feeling—amounting in the case of the Yorkshire Dales almost to a superstition—that husband and wife must share the same grave. To test the amount of this spurious assortative mating introduced by special urban conditions, we have collected a series of data from the cemeteries and graveyards on the north of London. Whereas the Records of the Society of Friends,—where every pair is given *without selection*—agree admirably with the two rural districts under investigation, the London results practically double the value of the apparent assortative mating. The agreement between the pedigree and rural graveyard results seems to indicate that the rural data are little influenced by any transitory character in the population. It is just possible that the slight increase of correlation as we pass from the Society of Friends Records to the very stable Yorkshire Dale population* and again to rural Oxfordshire may be really due to the source we find so markedly at work in the London series. The results given on p. 488 should be compared from this standpoint. All cases of second and third wives or husbands have been omitted from the tabulation. The proportion of cases in which a woman marries more than once is shewn by the records of the Society of Friends to be small, actually less than one per cent., so that the small fraction of these cases in the churchyard records, which may have escaped notice owing to the woman's change of name, cannot sensibly have affected our results. In Wensleydale at least it is very usual to find the names of both husbands in such cases given on the woman's tombstone.

3. The following is the material on which our results are based:

(*a*) *Yorkshire Dale Records.* These comprise tombstone records from Wensleydale, Wharfedale and adjacent dales. Among the places included were Hawes, Askrigg, Aysgarth, West Witton, Wensley, Middleham, Redmire, Muker, Arncliffe in Littondale, Kettlewell, Hubberholme, and Bolton Abbey. The great bulk of the tombstone entries in these parish churches refer to the farming population, the labouring class more rarely having stones, and the commercial class being a small element and in itself largely recruited from the farming class. The data were collected by C. D. Fawcett, A. Lee, W. F. R. Weldon and K. Pearson. The work of tabulation and calculation is due to F. E. Lutz and A. Lee.

(*b*) *Oxford Rural Records.* The country immediately round Oxford is studded with small villages, each with its own churchyard; the records are

* In many of the Yorkshire Dales it is possible to trace even the majority of the families back—many in the same houses—for several hundred years. A study of the church records shows a similar persistence in the labouring as well as in the farming or yeoman classes.

drawn from these, and the size of most such churchyards is sufficiently indicated by the fact that 37 of them yielded only 890 legible inscriptions of the kind required. The only town of any size included is Bicester; in this place the churchyard is sharply divided into an older portion, containing graves made before 1850, and a newer portion; the older portion only, as unlikely to be influenced by modern urban conditions, was tabulated.

The mass of the records relates undoubtedly to the farming population, including a considerable proportion of the labouring class, who obtain stone tombstones more easily in Oxfordshire, where building stone is cheap and easily cut, than in many places. The proportion of resident gentry, of clergy, and of professional men, is greater than in the Yorkshire records. The data were collected by F. Buchanan and W. F. R. Weldon, tabulated and reduced by K. Pearson, E. H. J. Schuster, and W. F. R. Weldon.

(*c*) *Records of the Society of Friends.* Collected by Mary Beeton from pedigrees, chiefly printed books at Devonshire House*. The material was tabulated and reduced by M. Beeton herself. While locally far more scattered than the material considered in (*a*) and (*b*), the Society of Friends forms a remarkably homogeneous body. Special features differentiating these data from the above rural district data are the far lower average age at death of both husband and wife, and, what does not appear in the results communicated in this paper, the occurrence with considerable frequency of remarkably early marriages.

(*d*) *London Cemeteries.* Data collected by Mary Beeton from St Mary-le-bone Cemetery, Highgate Cemetery, Hampstead Cemetery, and St John's Graveyard, Hampstead. The tabulation and reduction are due to M. Beeton.

(4) The above data cover a long range of years, both for husbands and wives, the lowest age at death being 18 years, the highest 107 years; these ages are subject to some uncertainty, because a man recorded as dying "in the 90th year of his age" may have died at any time between his 89th and 90th birthdays, and a man dying "aged 90" may have died at any time between his 90th and his 91st birthdays; further, it is by no means certain that the distinction between these two forms of statement is rigidly observed. In order to employ a unit of age which should not be affected by this uncertainty, and at the same time to lessen the work of tabulation, a five year period was adopted as the unit of age, both for husbands and for wives. The first question which arises is the effect, which may have been produced on the data, by the use of so large a unit; this was tested by F. E. Lutz, who determined the mean age at death and the standard deviation for husbands and wives from the Wensleydale district and the correlation between them, using first five years and then ten years as the unit age; using Sheppard's corrections for the moment formulae† he obtained the results given below; these

* See *R. S. Proc.* Vol. 67, p. 160. We desire again to express our thanks to Mr Isaac Sharpe for is courteous assistance.

† See *Biometrika*, Vol. I. p. 273.

show so close an agreement as to justify the belief that the system of grouping adopted is within wide limits immaterial:

	Five Year Unit		Ten Year Unit	
	Husbands	Wives	Husbands	Wives
Mean Age at Death ...	68·339	66·844	68·322	66·900
σ	13·965	16·396	13·887	16·222
r	$0{\cdot}2200 \pm 0{\cdot}0217$		$0{\cdot}2244 \pm 0{\cdot}0216$	

(5) Admitting that the units of age adopted have no sensible effect on the result, the correlation observed may be due to small environmental influences, affecting the group of persons from one parish in a district differently from those in other parishes. If such an effect existed, the mixture of records from different parishes would exhibit a spurious correlation, due to the heterogeneity of the material used. Such a spurious correlation would be independent of any real correlation between actual husbands and wives, and if it existed it would be equally apparent if the men and women from each parish were arranged in couples at random, the couples so formed for every parish in the district being then added together; accordingly F. E. Lutz took the records from each graveyard in the Wensleydale district, and arranged them in a series, after which a random couple was formed by taking with each man the wife of the man ten places removed from him in the series; this process being gone through for every graveyard in the district, the random couples formed were added together and arranged in Table II, from which it is found that the correlation between the age at death of one member of such a random couple and that of the other is $0{\cdot}0086 \pm 0{\cdot}0228$, a value differing from zero by less than half the probable error of the determination. This is sufficient proof that the observed correlation between actual husbands and wives is not due to environmental effects which act differently upon the married population of the different villages in the district.

(6) A further environmental effect remains to be considered: a husband and a wife live to a large extent in a similar environment, peculiar to themselves; they have on the whole the same nourishment, they live under similar sanitary conditions, and are probably subject to more nearly identical risk of zymotic disease than any random couple of individuals; lastly, the death of husband or wife is a shock affecting the survivor more intensely than anyone else, and often causing a sudden change in financial and other environmental conditions. All these circumstances, resulting directly from marriage, may be considered likely to produce a correlation between the age at death of husband and wife. This possibility was

tested by examination of the Oxford records. For every married pair the following data were calculated: (1) the excess of husband's age over wife's age at marriage, "the husband's seniority"; this quantity, called Δ, was tabulated in one year units; it is called positive when the husband is older than the wife, negative when the wife is the older; (2) the number of years during which the husband survives the wife; this quantity, called Δ', is clearly positive if the wife dies first, negative if the husband dies first. Calling H the length of husband's life, W that of the wife's life, we have as necessary relation between these four quantities

$$H = \Delta + W + \Delta'.$$

The mean value of Δ' was found to be $-1{\cdot}986$ years, showing that the wife in the Oxford district dies on an average 1·986 years after the death of her husband*. The environmental effect to be measured must, if it exists, be measured by its effect upon the coefficient of correlation between Δ' and the length of the wife's (or husband's) life. Taking the correlation between the age of the wife at death and the magnitude of Δ', the value found was

$$r_{\Delta' W} = -0{\cdot}6215 \pm 0{\cdot}0139;$$

the negative sign indicating that Δ' increases negatively with increased age of wife, or the older wives survive their husbands for a longer period than the younger, as it is, of course, obviously likely that they should do. The chance that a wife will survive her husband depends upon many things too complex for analysis; but one factor, which the data enables us to measure, is the difference between her age and that of her husband at marriage, or the value of Δ; if we consider two women of the same age, one marrying a man a year older than herself, while the other marries a man twenty years her senior, clearly one will be much more likely to survive her husband than the other. If, however, we consider the array of husbands and wives, including all those pairs for which Δ has a constant value, one factor, i.e. the expectation of the wife's survival, will be constant; and if within each such array the shock or the change in environment due to the death of husband or wife produce any sensible effect on the duration of life of the survivor, this is something peculiar to each pair within the array; accordingly, if we take all the husbands and wives in each such array, and form couples of men and women by random selection from among them, the relation between the death of one member of such a couple, and that of the other, will be independent of any environmental influences resulting from actual married life. If the Oxford records be treated in this way, and the value of Δ' computed for every random couple, the correlation between values of Δ' and the length of life of the woman placed in the couple may be determined; the difference between the value of r so obtained, and that obtained from a study of actual husbands and wives, will be a measure of the environmental effects referred to. The result of such a determination shows,

* The standard deviation of Δ' is 16·550 years. For Wensleydale it is 17·583, or there is greater variability in the survival period.

however, hardly any significant difference between the two correlations; we have for $r_{\Delta' W}$

In married pairs $r_{\Delta' W} = -0{\cdot}6215 \pm 0{\cdot}0139$

In random couples $r_{\Delta' W} = -0{\cdot}6576 \pm 0{\cdot}0128$

the difference between the two being practically negligible.

It appears, then, that the correlation between the length of life in husband and in wife is not sensibly due to any of the possible environmental effects considered. It must therefore be either a real phenomenon, or a result of some selection in the records from which the data were obtained, a possibility which has already been dealt with and dismissed.

(7) We are thus forced to conclude that the correlation actually observed between the length of life in two married persons is a measure of a real tendency towards homogamy, comparable with other cases of assortative mating. Collecting the results obtained, we find the following values.

Correlation between Length of Life in Husband and Wife.

Wensleydale and District ...	$0{\cdot}2200 \pm 0{\cdot}0244$
Oxfordshire	$0{\cdot}2500 \pm 0{\cdot}0211$
Society of Friends	$0{\cdot}1999 \pm 0{\cdot}0212$
Mean	0·2233

These values never differ by twice the probable error of their differences, and they are in remarkably good agreement with Pearson's value for the correlation of other physical characters in husband and in wife, the mean in which is 0·2257, thus affording further evidence for the propositions (1) that a very sensible amount of homogamy does occur in man, and (2) that length of life is a character which is subject to selection, as it has already been shown to be capable of hereditary transmission*. Both these propositions are clearly of great importance to the practical student of human evolution.

We thus reach the conception that husband and wife are as much alike as uncle and niece, and probably as much alike as, if not more alike than, first cousins; this is not only true for definite physical organs like stature and forearm, but also for the general physical constitution. Such a degree of resemblance is one which could certainly not have been anticipated, and which may even appear paradoxical to many.

The London cemeteries present us with an even higher degree of correlation between the durations of life of husband and wife, namely $0{\cdot}4204 \pm {\cdot}0176$. But we believe, as we have indicated above, that this apparent doubling of the assortative mating is solely due to the transitory nature of the population,—a spurious correlation produced by husband and wife being less frequently interred in the same grave when they die at a long interval apart.

* M. Beeton and K. Pearson: *Roy. Soc. Proc.*, Vol. 65, pp. 290—305.

(8) For only a certain portion of the Yorkshire material 662 out of the 876 pairs had Δ, the interval between the births of husband and wife, been recorded.

Comparing the Yorkshire and Oxfordshire data we have in years:

	Yorkshire		Oxfordshire	
	Mean	S.D.	Mean	S.D.
Δ	3·680	8·272	2·812	6·930
Δ′	−2·230	17·583	−1·986	16·550

Thus the north countryman has on the average about ·9 years more seniority over his wife than the Oxfordshire man. His wife might therefore be expected to survive him by a period longer by ·9 years than in Oxfordshire, but the difference in this respect is only ·24 years.

We place together here our whole data for length of life and its variability in the four series, the year being unit:

	Yorkshire				Oxfordshire		Friends' Records		London	
	876 Cases		662 Cases		890 Cases		935 Cases		1000 Cases	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Mean ...	68·329	66·844	68·716	67·266	68·461	67·635	66·508	62·578	67·090	66·250
Standard Deviation	12·965	16·396	13·903	15·639	12·698	14·668	15·262	19·378	13·136	14·057

We see from this table that:

(*a*) The rural married population has sensibly longer duration of life than the London series, or than the Friends' series, which undoubtedly contains many urban dwellers.

(*b*) The male is in every series longer lived than the female.

This is a result of very considerable interest, for in the country at large, and even in selected series, the duration of life of the female is greater than that of the male*. We are therefore compelled to conclude that the advantage of the woman lies in the unmarried members of the community. The married woman lives longer than the unmarried woman, as the married man lives longer than the unmarried man. But the life of the single woman is so much better than that

* *Biometrika*, Vol. I. pp. 53 and 60.

of the single man, that taking the whole population it more than compensates for the fact that the married man lives longer than the married woman.

(*c*) In all cases in the above table, and in fact in all the material we have yet examined for adults, duration of life is a more variable character in the woman than in the man.

(*d*) The raising of the mean lengths of life and the lowering of the variabilities when we take 662 out of the 876 Yorkshire cases, although slight is significant, and of some little interest, for it corresponds practically to a separation of the Wensleydale and Wharfedale data. It would seem to indicate that in the two adjacent dales there may really exist a slight differentiation in this character due either to a difference of race or to a difference of environment*.

(9) We have compared the Yorkshire and Oxfordshire series, namely in the relationship of the lengths of life of husband and wife (H and W) with the husband's seniority (Δ) at marriage and his survival period (Δ').

Correlation	Wensleydale	Oxfordshire
$r_{H\Delta}$	$0{\cdot}2029 \pm 0{\cdot}0251$	$0{\cdot}1246 \pm 0{\cdot}0223$
$r_{W\Delta}$	$-0{\cdot}1450 \pm 0{\cdot}0257$	$-0{\cdot}1743 \pm 0{\cdot}0219$
$r_{W\Delta'}$	$-0{\cdot}6158 \pm 0{\cdot}0163$	$-0{\cdot}6215 \pm 0{\cdot}0139$
$\rho_{H\Delta}$	$0{\cdot}2518$	$0{\cdot}1764$
$\rho_{W\Delta}$	$-0{\cdot}2091$	$-0{\cdot}2139$
$r_{\Delta\Delta'}$	$-0{\cdot}1810 \pm 0{\cdot}0254$	$-0{\cdot}1687 \pm 0{\cdot}0220$

This table shows at once a remarkably close agreement between the Oxfordshire and Wensleydale series for the correlations first between wife's length of life and husband's years of survival ($r_{W\Delta'}$) and secondly between husband's seniority and his years of survival ($r_{\Delta\Delta'}$). Within the limits of the numbers dealt with these correlations are identical for the two series, and are probably significant for the whole country. The most noteworthy feature is the comparatively small correlationship between the husband's seniority and the wife's survival period ($-\Delta'$). Looked at from the standpoint of regression we may say that in Wensleydale for every year that the husband exceeds the mean seniority of 3·680, the wife exceeds her mean survival period of 2·230 by ·385 years; while in Oxfordshire for every year that the husband exceeds the mean seniority of 2·812, the wife exceeds her mean survival period of 1·986 by ·403 years. This regression, sensibly the same for the two districts, is perhaps less than we might have anticipated; an increase

* Wensleydale runs roughly east and west, Wharfedale north and south for the part dealt with. If the sanitary and nurture conditions have changed much in the last two hundred years, which anyone well acquainted with the history of the Yorkshire dales will hardly admit, a third source of differentiation is possible. The *stone* of Wharfedale may be more lasting than that of Wensleydale, and thus in the former case a larger proportion of grave data from the 18th century may be included in the series.

of a year's seniority in the husband being accompanied by less than half a year's longer survival on the part of the wife.

To throw some light on this the *partial* correlations $\rho_{H\Delta}$ and $\rho_{W\Delta}$ are given. These measure the correlation between seniority of husband and the length of life of husband or wife for a *given length of life* of the other.

Thus $\rho_{W\Delta}$ is very substantial, or we see that among the array of wives who marry husbands of a given duration of life, that wife lives shortest whose husband has the greatest seniority. In other words great disparity in age between husband and wife tends to shorten the life of the younger of the pair. This must not be confused with the notion of 'shock' referred to on p. 486. For by the formula for partial correlation:

$$\rho_{W\Delta} = \frac{r_{W\Delta} - r_{WH}\, r_{H\Delta}}{\sqrt{1 - r^2_{WH}}\sqrt{1 - r^2_{H\Delta}}}$$

and this would have a finite value even if $r_{WH} = 0$, in fact the actual value of r_{WH} only influences $\rho_{W\Delta}$ in the second order of approximation. The essential part of the value of $\rho_{W\Delta}$ is due to the value of $r_{W\Delta}$, and the same remark applies to $\rho_{H\Delta}$ and $r_{H\Delta}$.

It would thus appear, that while men and women tend to select mates of physical constitutions similar to their own and leading to correlated durations of life, there is within this general tendency a rather more subtle factor at work, namely that when there is disparity of age, the older member of the pair either mates with an individual relatively less fitter to the environment than the older individual,—for example, if older men marry the less robust younger women —or else the disparity in age has a physically bad effect on the duration of life of the younger member of the pair. Whichever way we interpret the result this factor is one of very considerable interest and deserves investigation beyond the limits of a paper devoted to assortative mating. The above table suffices to show the sensible existence of this factor in very different sub-groups of the present English population. It also indicates how close the statistical constants we have dealt with remain when we pass from Yorkshire dales to Oxfordshire flats. We believe that similar results obtained from the graveyards in different parts of Great Britain would be of great value as throwing light on the influence of locality and local race on vital statistics.

(10) The main result of this paper is to demonstrate a very sensible degree of assortative mating in man, and we have already suggested the importance of this for the problem of evolution. But the field opened up leads us directly to a number of actuarial problems, which seem deserving of special consideration. They form another link in the chain which must ultimately draw together the actuary and the biologist. The actuary has been studying evolution without knowing it for generations; and the biologist to grasp evolution has got to do actuarial work not only for man, but for all types of life.

TABLE I.

Yorkshire Dales.

Age of Husbands.

Age of Wife.	25—29	30—34	35—39	40—44	45—49	50—54	55—59	60—64	65—69	70—74	75—79	80—84	85—89	90—94	95—99	Totals
20—24	—	2	—	—	—	—	—	—	1	—	3	—	—	—	—	6
25—29	—	2	1	—	—	1	1	—	2	1	2	—	—	—	—	10
30—34	—	2	2	4	2	1	1	4	6	2	3	1	1	—	—	29
35—39	—	3	—	1	2	2	2	4	5	5	2	3	3	—	—	32
40—44	—	1	—	4	2	3	2	5	7	6	8	1	—	—	—	39
45—49	—	3	3	—	2	1	2	5	7	3	2	2	1	—	1	32
50—54	—	2	—	1	2	2	3	7	3	5	9	4	3	3	—	44
55—59	—	—	1	2	3	2	4	3	10	10	9	4	2	2	2	54
60—64	—	—	4	4	2	4	11	15	13	12	9	5	5	—	—	84
65—69	2	2	3	3	4	5	5	9	19	19	23	12	3	2	—	111
70—74	—	1	2	4	5	3	7	14	16	20	22	14	8	—	—	116
75—79	—	—	3	1	8	7	6	19	10	17	21	20	9	2	1	124
80—84	1	1	1	2	8	5	1	6	16	21	21	19	6	4	1	113
85—89	—	—	—	1	3	3	1	5	6	8	8	14	7	3	—	59
90—94	—	—	—	—	—	—	3	—	3	2	4	2	1	1	—	16
95—99	—	—	—	1	—	—	—	1	—	3	1	—	—	—	1	7
Totals	3	19	20	28	43	39	49	97	124	134	147	101	49	17	6	876

TABLE II.

Yorkshire Dales. Correlation of random Pairs from same Graveyard.

Age of Man.

Age of Woman.	25—29	30—34	35—39	40—44	45—49	50—54	55—59	60—64	65—69	70—74	75—79	80—84	85—89	90—94	95—99	Totals
20—24	—	—	—	—	—	1	—	1	2	—	—	2	—	—	—	6
25—29	—	—	—	—	1	—	—	2	2	1	—	4	—	—	—	10
30—34	—	—	1	1	1	1	—	5	4	3	8	1	4	—	—	29
35—39	1	1	1	—	1	1	1	8	5	2	7	3	—	1	—	32
40—44	—	1	1	—	4	—	3	2	3	7	8	5	4	—	1	39
45—49	—	—	2	—	1	2	3	5	2	7	6	3	1	—	—	32
50—54	—	1	2	1	2	3	1	7	7	4	11	1	—	4	—	44
55—59	—	2	2	3	3	—	2	6	6	8	11	5	4	1	1	54
60—64	—	1	1	2	5	4	8	13	12	9	13	9	6	1	—	84
65—69	—	4	—	4	5	11	4	9	22	21	17	8	6	—	—	111
70—74	—	2	5	8	4	4	8	6	16	17	19	16	8	2	1	116
75—79	1	2	—	5	6	5	9	10	16	25	21	15	6	3	—	124
80—84	—	4	3	1	4	6	3	14	15	16	17	17	7	3	3	113
85—89	1	1	1	3	1	1	6	8	8	11	5	9	3	1	—	59
90—94	—	—	1	—	3	—	1	—	3	3	4	—	—	1	—	16
95—99	—	—	—	—	2	—	—	1	1	—	—	3	—	—	—	7
Totals	3	19	20	28	43	39	49	97	124	134	147	101	49	17	6	876

TABLE III.

Ages at Death of Husbands and Wives. Yorkshire Dales, Wensleydale and district only.

Husband's Age at Death.

Wife's Age at Death.	25—29	30—34	35—39	40—44	45—49	50—54	55—59	60—64	65—69	70—74	75—79	80—84	85—89	90—94	95—99	Totals
20—24	—	2	—	—	—	—	—	—	1	—	1	—	—	—	—	4
25—29	—	2	1	—	—	1	1	—	2	—	2	—	—	—	—	9
30—34	—	2	1	2	2	1	—	2	3	1	1	—	—	—	—	15
35—39	—	1	—	1	2	2	2	4	4	3	1	3	2	—	—	25
40—44	—	1	—	2	2	3	2	5	6	3	5	1	—	—	—	30
45—49	—	2	1	—	1	1	2	4	4	2	2	2	—	—	1	22
50—54	—	—	—	1	2	2	2	2	2	5	7	4	3	3	—	33
55—59	—	—	1	2	3	2	3	3	5	9	8	2	1	1	2	42
60—64	—	—	3	3	1	3	8	9	9	12	8	3	2	—	—	61
65—69	1	1	2	4	1	2	4	8	13	14	13	11	3	1	—	78
70—74	—	—	1	4	4	3	6	13	10	14	16	12	6	—	—	89
75—79	—	—	3	1	7	6	4	14	9	16	21	16	9	2	1	109
80—84	1	1	1	2	6	1	1	5	13	16	17	15	6	3	1	89
85—89	—	—	—	1	1	1	1	3	5	5	5	12	5	3	—	42
90—94	—	—	—	—	—	—	3	—	3	—	2	2	1	1	—	12
95—99	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	2
Totals	2	12	14	23	32	28	39	72	89	101	110	83	38	14	5	662

TABLE IV.

Correlation of Husband's Duration of Life, and his Seniority. Wensleydale and District.

Husband's Age at Death.

Husband's Seniority. Years	25—29	30—34	35—39	40—44	45—49	50—54	55—59	60—64	65—69	70—74	75—79	80—84	85—89	90—94	95—99	Totals
−20	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
−19	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
−16	—	—	1	—	—	—	—	—	—	—	—	1	1	—	—	3
−15	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	2
−13	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
−12	—	—	—	1	—	—	1	—	—	3	—	—	—	—	—	5
−11	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
−10	—	—	—	—	1	—	2	1	—	—	—	—	—	—	—	4
− 9	—	—	—	1	—	1	1	1	1	3	—	—	—	—	—	8
− 8	—	—	—	2	—	—	—	4	—	—	1	3	1	—	—	11
− 7	—	—	—	—	—	—	—	1	1	1	1	—	1	—	—	5
− 6	—	1	—	1	—	3	—	1	1	3	—	2	—	—	—	12
− 5	—	—	—	1	1	—	—	4	4	2	1	2	—	—	—	15
− 4	—	1	—	2	1	—	2	2	3	7	2	3	—	—	—	23
− 3	—	1	—	2	3	1	1	2	3	2	4	—	1	—	—	20
− 2	—	—	—	1	1	1	2	3	8	5	5	4	3	—	—	33
− 1	1	2	3	1	4	1	2	1	3	5	7	4	1	—	—	35
0	—	3	1	1	1	2	2	9	7	9	10	6	1	2	—	54
+ 1	1	—	1	—	1	2	6	6	7	6	6	6	2	—	—	44
+ 2	—	1	2	3	2	4	2	4	8	7	10	8	4	—	—	55
+ 3	—	—	1	2	3	2	4	2	5	4	5	4	2	1	—	35
+ 4	—	2	2	2	2	3	1	6	6	6	9	5	—	2	—	46
+ 5	—	1	1	1	1	1	3	6	4	9	3	6	4	2	—	42
+ 6	—	—	—	1	1	—	1	2	4	4	8	2	4	1	—	28
+ 7	—	—	—	—	3	2	4	3	3	4	4	2	1	—	—	26
+ 8	—	—	—	1	1	1	—	3	7	2	4	6	—	3	—	28
+ 9	—	—	1	—	1	1	1	3	1	4	1	2	2	1	—	18
+10	—	—	—	—	1	—	2	—	1	1	3	3	—	—	1	12
+11	—	—	—	—	—	—	—	1	2	1	3	—	1	—	—	8
+12	—	—	—	—	—	2	—	1	1	2	1	2	1	—	—	10
+13	—	—	—	—	1	—	1	1	3	—	3	2	2	—	—	13
+14	—	—	—	—	—	—	—	—	1	1	—	—	—	1	1	4
+15	—	—	—	—	1	—	—	—	—	2	—	1	—	1	—	5
+16	—	—	—	—	—	—	—	—	1	—	5	1	—	—	1	8
+17	—	—	—	—	—	—	—	1	—	1	1	—	—	—	—	3
+18	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
+19	—	—	—	—	—	1	1	—	1	3	1	—	—	—	1	8
+20	—	—	—	—	—	—	—	1	—	—	1	—	2	—	—	4
+21	—	—	—	—	1	—	—	—	—	—	—	1	1	—	—	3
+22	—	—	—	—	—	—	—	1	—	—	2	1	1	—	—	5
+23	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	2
+24	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
+25	—	—	—	—	—	—	—	—	—	2	1	1	1	—	—	5
+26	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	2
+27	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+28	—	—	—	—	—	—	—	1	—	—	1	1	—	—	—	3
+29	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
+30	—	—	—	—	—	—	—	—	—	—	1	1	1	—	—	3
+31	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
+32	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
+35	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
+52	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
+53	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Totals	2	12	14	23	32	28	39	72	89	101	110	83	38	14	5	662

TABLE V.

Correlation of Wife's Duration of Life and Husband's Seniority. Wensleydale and District.

Wife's Age at Death.

Husband's Seniority. Years	20—24	25—29	30—34	35—39	40—44	45—49	50—54	55—59	60—64	65—69	70—74	75—79	80—84	85—89	90—94	95—99	Totals
−20	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
−19	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
−16	—	—	—	—	—	—	1	—	—	1	—	1	—	—	—	—	3
−15	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	2
−13	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
−12	—	—	—	—	—	—	—	1	—	2	—	—	1	1	—	—	5
−11	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
−10	—	—	—	—	—	—	—	1	—	1	1	1	—	—	—	—	4
− 9	—	—	—	—	—	—	—	1	—	2	1	2	2	—	—	—	8
− 8	—	—	—	—	—	1	—	—	1	—	3	2	2	1	—	1	11
− 7	—	—	—	—	—	—	—	1	—	1	—	1	1	1	—	—	5
− 6	—	—	—	1	1	—	—	—	—	1	3	4	2	—	—	—	12
− 5	—	—	—	1	—	1	—	1	1	1	3	4	2	1	—	—	15
− 4	—	—	—	—	2	—	1	1	3	3	2	6	4	1	—	—	23
− 3	—	—	—	1	—	—	—	—	3	1	5	4	2	3	1	—	20
− 2	—	—	—	—	1	2	1	3	5	2	5	4	9	—	1	—	33
− 1	—	—	—	—	—	4	—	3	3	6	3	9	4	3	—	—	35
0	—	2	1	—	3	—	4	5	3	8	3	8	7	7	2	1	54
+ 1	—	1	1	3	4	—	1	—	5	12	4	8	3	1	1	—	44
+ 2	1	—	2	5	3	1	4	3	1	4	10	9	9	1	2	—	55
+ 3	—	1	—	2	1	2	1	2	4	5	3	5	6	2	1	—	35
+ 4	1	—	3	—	2	—	4	6	3	3	8	9	2	4	1	—	46
+ 5	1	—	1	2	1	2	2	1	5	3	8	4	7	5	—	—	42
+ 6	1	2	—	—	1	—	1	1	2	—	4	6	8	1	1	—	28
+ 7	—	—	1	6	—	2	3	1	1	3	2	4	2	1	—	—	26
+ 8	—	2	1	—	2	—	2	4	4	—	3	4	1	5	—	—	28
+ 9	—	1	—	1	2	—	—	1	4	4	1	2	1	—	1	—	18
+10	—	—	1	—	1	—	—	—	1	1	4	1	2	1	—	—	12
+11	—	—	1	1	—	1	—	—	—	2	2	1	—	—	—	—	8
+12	—	—	—	1	—	1	—	1	1	1	1	2	2	—	—	—	10
+13	—	—	—	—	—	—	1	1	3	1	4	—	3	—	—	—	13
+14	—	—	—	—	1	1	—	—	—	—	—	2	—	—	—	—	4
+15	—	—	1	—	—	—	—	—	1	1	—	—	2	—	—	—	5
+16	—	—	—	—	—	—	—	2	—	1	2	1	1	1	—	—	8
+17	—	—	—	—	—	—	—	—	2	—	—	1	—	—	—	—	3
+18	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
+19	—	—	—	—	2	1	—	1	—	2	2	—	—	—	—	—	8
+20	—	—	—	—	1	—	1	—	—	1	—	—	—	1	—	—	4
+21	—	—	—	—	—	—	—	—	—	2	—	—	1	—	—	—	3
+22	—	—	—	1	—	1	2	—	—	—	—	1	—	—	—	—	5
+23	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	2
+24	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
+25	—	—	—	—	—	—	2	1	—	—	—	1	—	—	1	—	5
+26	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	2
+27	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+28	—	—	—	—	—	—	—	—	1	—	—	—	1	1	—	—	3
+29	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
+30	—	—	—	—	—	—	—	—	2	—	—	1	—	—	—	—	3
+31	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
+32	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
+35	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
+52	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
+53	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
Totals	4	9	15	25	30	22	33	42	61	78	89	109	89	42	12	2	662

TABLE VI.

Villages round Oxford. Correlations of Lengths of Life of Husband and Wife.

Age of Husbands.

Age of Wives.	20—24	25—29	30—34	35—39	40—44	45—49	50—54	55—59	60—64	65—69	70—74	75—79	80—84	85—89	90—94	95—99	Totals
15—19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20—24	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	2
25—29	—	—	—	1	—	—	—	—	1	2	—	—	1	—	—	—	5
30—34	—	—	1	3	3	—	7	—	2	1	2	2	—	—	1	—	22
35—39	—	—	1	3	1	—	1	1	5	2	5	2	2	—	—	—	23
40—44	—	—	—	1	3	3	1	7	3	4	7	3	4	—	—	—	36
45—49	—	—	—	1	2	3	8	—	5	3	7	3	2	4	1	—	39
50—54	—	—	—	—	5	4	5	5	10	6	10	8	4	—	—	—	57
55—59	—	—	—	1	1	3	6	6	5	8	7	6	4	5	1	—	53
60—64	—	—	—	1	—	4	3	8	8	12	13	12	8	3	2	—	74
65—69	—	—	—	1	3	6	5	8	10	19	17	22	13	4	1	—	109
70—74	—	1	3	—	4	5	12	11	21	22	31	23	16	4	5	—	158
75—79	—	1	—	1	—	3	4	7	14	19	22	27	15	7	3	—	123
80—84	—	—	—	—	3	2	4	8	10	17	20	16	19	14	4	1	118
85—89	—	1	—	—	—	2	3	6	3	9	7	11	10	2	—	—	54
90—94	—	—	—	—	—	1	2	1	—	4	2	1	3	1	—	—	15
95—99	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	2
Totals	—	3	5	13	25	37	62	68	97	128	151	137	101	44	18	1	890

TABLE VII.

Villages round Oxford. Random pairs, Man with same seniority over Woman as in the case of the Man's actual Wife.

Age of Man.

Age of Woman.	25—29	30—34	35—39	40—44	45—49	50—54	55—59	60—64	65—69	70—74	75—79	80—84	85—89	90—94	95—99	Totals
20—24	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	2
25—29	—	—	—	—	1	—	—	1	1	—	—	1	1	—	—	5
30—34	—	—	—	2	1	—	1	5	2	2	5	2	1	1	—	22
35—39	1	1	—	—	—	3	1	3	4	4	4	2	—	—	—	23
40—44	—	—	2	—	3	3	4	5	3	5	4	6	—	—	1	36
45—49	—	—	—	1	2	3	5	2	10	7	4	4	1	—	—	39
50—54	—	—	—	1	—	7	3	7	10	7	10	7	4	1	—	57
55—59	—	1	1	3	—	2	4	2	4	13	9	8	5	1	—	53
60—64	—	—	2	3	6	5	9	9	7	7	15	7	2	2	—	74
65—69	—	1	1	4	4	7	11	10	22	19	13	10	3	4	—	109
70—74	2	1	1	2	6	13	6	20	24	35	21	13	9	5	—	158
75—79	—	1	4	5	4	10	9	12	14	17	21	18	8	—	—	123
80—84	—	—	2	2	6	4	10	15	16	23	18	13	8	1	—	118
85—89	—	—	—	2	4	4	2	2	8	9	13	8	2	—	—	54
90—94	—	—	—	—	—	1	3	2	1	3	—	2	—	3	—	15
95—99	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	2
Totals	3	5	13	25	37	62	68	97	128	151	137	101	44	18	1	890

TABLE VIII.

Oxfordshire.

Husband's Age.

Husband's Seniority. Years	25—29	30—34	35—39	40—44	45—49	50—54	55—59	60—64	65—69	70—74	75—79	80—84	85—89	90—94	95—99	Totals
−25	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
−21	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	2
−20	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	2
−19	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
−15	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
−14	—	—	—	—	—	—	—	—	—	—	2	1	—	—	—	3
−13	—	1	—	—	1	—	—	—	1	—	—	—	—	—	—	3
−12	—	—	—	—	1	—	1	—	—	1	2	—	—	—	—	5
−11	—	—	—	—	—	1	—	1	1	1	—	1	—	—	—	5
−10	—	—	1	—	1	1	1	1	1	—	2	—	1	1	—	10
− 9	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	2
− 8	—	—	—	1	2	—	2	3	1	1	—	—	—	—	—	10
− 7	—	—	—	—	—	1	2	2	—	2	2	3	—	—	—	12
− 6	—	—	—	—	—	—	2	1	3	2	3	—	1	—	—	12
− 5	—	1	1	1	—	3	4	4	3	3	3	2	1	1	—	27
− 4	—	—	—	—	2	1	—	3	3	5	3	5	1	—	—	23
− 3	—	—	1	2	5	3	—	7	3	5	—	4	—	1	—	31
− 2	—	—	2	1	3	3	8	6	8	9	7	6	2	—	—	55
− 1	1	—	—	1	2	4	4	8	16	7	10	3	2	4	—	62
0	—	—	1	3	—	3	4	7	14	12	11	7	3	—	—	65
+ 1	—	—	1	1	5	8	3	6	7	13	5	6	1	—	—	56
+ 2	1	1	2	3	3	2	5	5	9	13	13	9	1	3	—	70
+ 3	1	1	1	3	5	5	4	9	12	7	8	7	5	—	—	68
+ 4	—	—	—	1	—	5	7	4	5	11	9	11	3	—	1	57
+ 5	—	1	2	2	1	2	3	1	8	9	11	3	2	1	—	46
+ 6	—	—	—	—	1	3	4	5	6	6	5	5	5	1	—	41
+ 7	—	—	1	—	—	2	3	7	5	3	3	6	3	1	—	34
+ 8	—	—	—	1	1	2	1	2	3	8	7	4	2	2	—	33
+ 9	—	—	—	2	1	1	2	3	2	4	5	4	1	1	—	26
+10	—	—	—	2	—	1	5	4	4	2	7	1	—	1	—	27
+11	—	—	—	1	—	1	—	2	1	5	2	—	1	—	—	13
+12	—	—	—	—	1	1	1	1	2	3	4	2	—	—	—	15
+13	—	—	—	—	—	4	—	—	3	2	1	4	2	—	—	16
+14	—	—	—	—	—	—	—	1	2	1	—	2	1	—	—	7
+15	—	—	—	—	—	—	—	1	1	4	—	2	3	—	—	11
+16	—	—	—	—	1	1	—	—	2	1	3	—	1	—	—	9
+17	—	—	—	—	—	1	—	—	—	—	—	—	1	—	—	2
+18	—	—	—	—	—	—	—	1	—	—	2	—	1	—	—	4
+19	—	—	—	—	—	—	—	—	—	1	1	1	—	—	—	3
+20	—	—	—	—	—	—	—	—	—	1	2	1	—	—	—	4
+21	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	2
+22	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	2
+23	—	—	—	—	—	1	—	—	1	1	—	—	—	—	—	3
+24	—	—	—	—	—	—	—	1	—	2	—	—	—	—	—	3
+25	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
+26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+27	—	—	—	—	—	—	—	—	—	1	1	—	—	1	—	3
+28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+29	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
+30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+33	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
Totals	3	5	13	25	37	62	68	97	128	151	137	101	44	18	1	890

TABLE IX.

Oxfordshire.

Wife's Age.

Husband's Seniority.

	15—19	20—24	25—29	30—34	35—39	40—44	45—49	50—54	55—59	60—64	65—69	70—74	75—79	80—84	85—89	90—94	95—99	Totals
−25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
−21	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	2
−20	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	2
−19	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
−15	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
−14	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	1	3
−13	—	—	—	—	—	—	—	—	—	—	—	1	2	—	—	—	—	3
−12	—	—	—	—	—	—	—	—	—	1	1	1	1	1	—	—	—	5
−11	—	—	—	—	—	—	—	—	1	—	—	—	2	1	1	—	—	5
−10	—	—	—	—	—	—	1	1	1	1	1	3	2	—	—	—	—	10
− 9	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	2
− 8	—	—	—	—	—	—	—	1	—	1	1	1	3	—	2	1	—	10
− 7	—	—	—	—	—	—	—	—	—	1	3	2	2	2	1	1	—	12
− 6	—	—	—	—	—	—	—	1	—	—	2	3	4	1	—	1	—	12
− 5	—	—	—	—	—	1	1	1	1	3	2	8	4	4	2	—	—	27
− 4	—	—	—	1	—	2	1	1	2	4	1	3	1	5	2	—	—	23
− 3	—	—	—	2	—	—	2	3	1	4	5	5	3	2	3	1	—	31
− 2	—	—	—	2	2	2	3	1	4	5	6	10	7	8	3	2	—	55
− 1	—	—	—	—	1	2	4	2	3	3	9	14	10	7	5	2	—	62
0	—	—	—	1	2	1	3	4	7	4	8	16	7	6	5	1	—	65
+ 1	—	—	—	2	—	2	2	5	2	4	9	11	9	8	1	1	—	56
+ 2	—	—	—	—	2	7	3	1	4	5	11	12	10	11	3	1	—	70
+ 3	—	—	—	3	2	2	3	6	3	5	10	11	13	4	6	—	—	68
+ 4	—	—	—	1	4	2	3	4	3	2	8	8	3	15	3	1	—	57
+ 5	—	—	—	—	4	2	3	4	1	6	5	8	5	5	2	1	—	46
+ 6	—	—	1	2	1	—	1	1	2	4	5	13	6	4	1	—	—	41
+ 7	—	—	1	1	—	2	1	3	2	4	1	5	5	7	2	—	—	34
+ 8	—	—	—	2	1	1	1	3	1	2	2	9	4	6	1	—	—	33
+ 9	—	—	1	1	—	3	—	2	2	4	3	2	—	5	3	—	—	26
+10	—	—	—	—	—	1	2	3	4	5	2	—	2	4	2	2	—	27
+11	—	—	—	1	1	—	1	—	1	1	3	2	2	—	1	—	—	13
+12	—	—	1	—	—	1	—	1	3	—	2	4	2	—	1	—	—	15
+13	—	—	—	—	1	1	1	—	—	3	3	2	3	—	1	—	1	16
+14	—	—	—	—	—	1	1	1	1	—	—	—	1	2	—	—	—	7
+15	—	—	1	—	—	—	1	—	1	—	2	1	2	2	1	—	—	11
+16	—	—	—	2	—	1	—	1	1	1	1	—	1	1	—	—	—	9
+17	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	2
+18	—	—	—	—	—	—	—	1	—	1	—	1	1	—	—	—	—	4
+19	—	—	—	—	—	—	—	2	—	—	—	—	1	—	—	—	—	3
+20	—	—	—	—	1	1	—	—	—	—	1	—	1	—	—	—	—	4
+21	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	2
+22	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	2
+23	—	1	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	3
+24	—	—	—	—	1	—	1	—	—	—	—	—	—	1	—	—	—	3
+25	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
+26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+27	—	—	—	—	—	—	—	—	—	—	2	—	—	1	—	—	—	3
+28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+29	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
+30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
+33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
Totals	—	2	5	22	23	36	39	57	53	74	109	158	123	118	54	15	2	890

TABLE X.

Records of Society of Friends.

Age of Husband.

Age of Wife.	24—28	29—33	34—38	39—43	44—48	49—53	54—58	59—63	64—68	69—73	74—78	79—83	84—88	89—93	94—98	99—103	Totals
18— 22	2	1	1	—	—	1	2	1	1	—	1	2	—	—	—	—	12
23— 27	5	4	2	—	3	4	1	1	2	2	4	—	1	—	—	1	30
28— 32	1	1	2	3	3	6	3	4	4	3	5	1	2	—	—	—	38
33— 37	1	1	3	2	9	10	3	8	8	4	12	3	6	2	—	—	72
38— 42	1	1	4	4	3	6	5	3	4	4	8	2	2	—	—	—	47
43— 47	1	1	3	1	3	3	4	3	4	5	7	4	2	—	1	—	42
48— 52	—	—	1	—	3	6	4	7	6	4	5	3	4	—	—	—	43
53— 57	—	—	—	2	4	—	2	5	3	6	8	5	6	1	—	—	42
58— 62	—	—	2	3	1	4	7	9	8	9	13	2	7	—	—	—	65
63— 67	1	—	2	3	1	5	8	8	9	17	13	11	4	1	2	—	85
68— 72	—	2	1	1	11	4	6	13	15	13	20	10	7	1	1	—	105
73— 77	—	—	2	—	7	3	3	10	17	11	17	20	10	4	1	—	105
78— 82	—	1	1	4	5	5	7	5	13	11	24	19	16	1	1	—	113
83— 87	1	—	—	2	3	1	9	4	7	4	13	13	18	3	1	—	79
88— 92	1	—	2	—	1	1	1	4	5	7	9	6	2	2	—	1	42
93— 97	—	—	—	1	1	2	—	1	1	3	1	1	—	—	1	—	12
98—102	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	2
103—107	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
Totals	14	12	26	26	58	62	66	87	107	103	160	102	87	15	8	2	935

TABLE XI.

London Cemeteries.

Age of Husband.

Age of Wife.	24—28	29—33	34—38	39—43	44—48	49—53	54—58	59—63	64—68	69—73	74—78	79—83	84—88	89—93	94—98	Totals
20—24	1	—	—	—	2	—	—	—	—	—	—	—	—	—	—	3
25—29	1	1	1	—	1	1	—	1	—	—	—	—	—	—	—	6
30—34	—	2	4	2	1	—	—	1	—	—	2	—	1	—	—	13
35—39	1	2	4	3	3	3	5	4	1	5	5	—	—	—	—	36
40—44	—	1	3	3	3	6	4	6	2	2	3	2	—	—	—	35
45—49	—	1	3	3	7	5	6	3	—	5	4	3	2	—	—	42
50—54	—	1	2	2	3	9	10	13	11	13	4	6	1	—	—	75
55—59	—	—	—	3	3	12	11	10	15	12	9	4	3	—	—	82
60—64	—	—	—	1	2	9	16	20	17	22	20	13	2	1	—	123
65—69	1	1	1	2	1	6	8	26	23	23	24	9	8	1	1	135
70—74	—	—	2	—	6	3	7	16	16	34	29	22	7	3	—	145
75—79	—	—	2	1	5	2	5	15	21	34	25	25	7	5	2	149
80—84	1	—	—	—	3	6	4	11	10	10	17	27	11	—	1	101
85—89	—	—	—	2	1	3	1	3	6	6	3	5	8	3	—	41
90—94	—	—	—	—	—	—	1	2	—	2	—	—	2	—	—	7
95—99	—	—	—	—	—	1	—	1	—	2	2	—	1	—	—	7
Totals	5	9	22	22	41	66	78	132	122	170	147	116	53	13	4	1000

MISCELLANEA.

I. **Inheritance in** *Phaseolus vulgaris.*

Professor F. Johannsen has just published a summary of his recent experiments on inheritance. His work *Ueber Erblichkeit in Populationen und in reinen Linien* (Fischer, Jena, 1903) is dedicated to Francis Galton, as the "Schöpfer der exakten Erblichkeitslehre"; it shows that the author has realised the importance of adequate statistical methods in any attempt to deal with the problem of inheritance, and we wish to express our gratitude to him for the courteous tone adopted in speaking of "Biometriker," and for the patient effort he has made to understand their work.

Professor Johannsen's material is collected from three generations of beans: he has (1) a series of individual seeds, chosen out of a sample of about 16,000, which had been harvested and mixed together; these afford his evidence concerning the character of a grandmaternal generation; (2) each grandmaternal bean, when sown, yielded a crop of maternal beans, the mean character (weight or length-breadth index) of those borne by one plant being taken as the measure of the maternal character of the line of ancestry to which the plant belongs; (3) from the series of seeds borne by each mother plant, a certain number (from two to seven) were sown, the mean characters of the seeds borne by the resulting plants being taken as a measure of the characters studied in the filial generation of each line.

From these data three principal sets of tables are constructed; on p. 25, *Uebersichtstabelle* I. gives material for measuring the regression of individual filial beans on the mean weight of the maternal beans; a series of tables on pp. 21—24 gives the relation between the weights of the individual beans of the maternal plants, which were sown, and the mean weight of the seed produced by every resultant plant; finally on pp. 36—37 a table is given which Professor Johannsen believes to show that the progeny of every seed, within a particular line of ancestry, exhibits a complete "Rückschlag" to the type of its line, the coefficients of correlation and regression between parent and offspring within the line being each = 0.

On the basis of these tables Professor Johannsen attempts to explain the apparent discrepancy between Galton's law of regression and the results obtained by de Vries and others: but his view of the consequences supposed by "Biometriker" to follow from Galton's results shows that he has not fully realised what those consequences are.

It is fully realised by "Biometriker" that the general regression observed when we compare a filial generation with a parental generation is compounded of a series of sub-regressions, the members of each line of ancestry regressing to the "type" of their line; the effect of selecting definite ancestry for a small number of generations is also recognised; these points were fully dealt with in 1898, although few biologists seem to have realised the fact; it was then said:

"We now see that with the law of ancestral heredity.....a race with six generations of "selection will breed within 1·2 per cent. of truth ever afterwards,"* or in other words the

* K. Pearson: "On the Law of Ancestral Heredity," *Roy. Soc. Proc.* Vol. 62, 1898. Cf. pp. 397—402, "On the Variability and Stability of Selected Stock."

fixity of a line of ancestry is asserted when the ancestral purity is far less than that involved in Professor Johannsen's "reine Linie," which he defines as consisting of "Individuen, welche "von einem einzelnen selbst befruchtenden Individuum abstammen" (p. 9).

Again, "with a view to reducing the *absolute* variability of a species it is idle to select beyond "grandparents, and hardly profitable to select beyond parents. The ratio of the variability of "pedigree stock to the general population decreases 10 per cent. on the selection of parents, and "only 11 per cent. on the additional selection of grandparents. Beyond this no sensible change "is made."*

In these two passages the fixity of the type and the high variability of individuals about the type are asserted as absolutely as they are asserted by de Vries in the passage of the *Mutationstheorie* quoted by Professor Johannsen. With our present knowledge of the coefficients of inheritance in man, horse, and dog, it would seem that from 2 to 4 generations of selection suffice to form a line varying greatly about its type, yet remaining true to that type. When we are told that a bean breeds true to its line we are told something which has been shown to be a necessary consequence of the law of ancestral heredity; if it were not true, the whole law would be upset.

The difference between the view put forward by Professor Johannsen, and that expressed in 1898 in the paper "On the Law of Ancestral Inheritance" is therefore not a difference which concerns the focus of regression in the offspring of selected ancestors; it is simply a difference as to the relation between successive generations of individuals within the line of ancestry. Professor Johannsen believes the tables on pp. 21—24 of his work to show that "*die persönliche "Beschaffenheit der Eltern, Grosseltern, oder irgend eines Ahnen hat*—soweit meine Erfahrung "reicht—*keinen Einfluss auf den durchschnittlichen Charakter der Nachkommen.* Es ist aber "*der Typus der Linie*, welche den durchschnittlichen Character der Individuen bestimmt....." (pp. 61—62). Within the same line of ancestry, whatever individuals of a generation be chosen as parents, the character of the resultant filial generation will be the same according to Professor Johannsen, or the coefficients of correlation and regression between parents and offspring, within the same line of ancestry, will each = 0.

The experimental results do not seem to us consistent with this view. If the offspring of every generation, within a given line of ancestry, breed true to the type of their line, subject to such seasonal and climatic influences as affect the whole generation of their year, then when the whole filial generation is compared with the whole parental generation, correlation between the two must necessarily be perfect, and the coefficient of regression must be simply the ratio between the standard deviations of the two generations. Professor Johannsen should, we think, first have shown that perfect correlation does in fact exist between parents and offspring in two successive generations of plants; and this he has failed to do; in the case of his maternal and filial generations he has, however, published data which enable us to determine the required correlation, and the table below gives the result. With such data, the only method available is the first method used for Shirley Poppies†. It consists in determining the correlation between *every individual bean* of the filial generation, and the *mean character of its parent.* The absolute value of the correlation so obtained will not be significant, but the coefficient of regression will closely represent the true parental correlation,—being a relation between mean filial character and mean parental character. Taking Professor Johannsen's *Uebersichtstabelle* I. (p. 25), and the maternal means given on pp. 21—24, the following table has been constructed, giving a coefficient of correlation = 0·531 and of regression = 0·591 ± 0·125. This latter value represents the coefficient of correlation, so far as the data allow it to be determined, between filial and maternal plants; and considering the paucity of maternal plants (only 19) the result is not in bad accord with previous results for parental correlation‡. The value 0·591 ± 0·125 is not very divergent from 0·5, but it cannot be held to approximate to unity!

* Pearson: *loc. cit.* † *Biometrika*, Vol. II. Part I. p. 69.

‡ *Biometrika*, Vol. II. p. 379.

Mean Maternal Beans

TABLE A.

Correlation between Individual Filial Beans and Mean Maternal Beans.

Filial Beans.

Mean Maternal Beans: Weights in milligrams	10—15	15—20	20—25	25—30	30—35	35—40	40—45	45—50	50—55	55—60	60—65	65—70	70—75	75—80	80—85	85—90	Totals
A & *D* 600	—	—	—	5	2	11	26	47	82	98	84	46	26	17	6	2	452
C 570	—	—	—	—	—	5	14	50	76	58	44	29	5	1	—	—	282
B 520	—	—	—	1	6	19	32	66	88	100	90	50	19	1	3	—	475
E 512	—	—	—	4	1	12	29	62	65	57	19	6	—	—	—	—	255
K 510	—	—	1	2	6	31	55	55	28	6	4	—	—	—	—	—	188
Q 440	—	—	1	2	7	16	44	93	80	52	10	—	—	—	—	—	305
R 410	—	—	—	2	3	12	17	27	19	3	—	—	—	—	—	—	83
S 405	—	—	1	2	3	8	27	47	37	30	4	—	—	—	—	—	159
G & *J* 400	—	1	5	23	66	155	283	353	241	97	15	—	1	5	—	—	1245
F & *T* 395	—	—	—	2	9	27	66	111	85	58	22	1	1	—	—	—	382
P 390	—	—	—	3	1	18	35	27	13	3	4	2	—	—	—	—	106
H 380	—	—	1	6	20	60	106	114	75	33	3	—	—	—	—	—	418
L 360	—	—	1	5	15	37	88	76	33	13	4	1	—	—	—	—	273
M 340	—	—	4	9	26	56	82	76	32	9	1	—	—	—	—	—	295
N 312	1	3	11	22	29	72	120	69	23	5	2	—	—	—	—	—	357
O 310	4	4	5	19	69	69	44	5	—	—	—	—	—	—	—	—	219
Totals	5	8	30	107	263	608	1068	1278	977	622	306	135	52	24	9	2	5494

The letters *A* to *T* are used by Professor Johannsen to denote his nineteen "pure lines."

If Professor Johannsen's hypothesis were true, the only way in which he could account for the regression here observed,—a regression whose existence he himself admits,—would be by assuming that the characters, by which he has described the plants of his pure lines, are imperfectly correlated with the actual mean characters of his plants which he supposes to represent the types of his lines; but this assumption, while leaving his hypothesis logically unshaken, would destroy the whole value of his experiments as evidence in its favour, by destroying the value of the measure by which he has determined the characters studied.

Some of the difficulties we have felt in following Professor Johannsen are undoubtedly due to the imperfect way in which he has measured the characters of ancestral plants*. The *grandmaternal plants*, for example, are determined each by the character of a single bean; the small value of such a determination may be judged from the variability among the beans of a single plant produced by the last generation; the mean number of such beans was 84·5, and the mean standard deviation of all arrays due each to a single plant was 75·37 milligrams, so that the mean character of a mother-plant, inferred from a single bean chosen at random among the offspring, would be equally likely to lie inside or outside the limits (true maternal mean + 50 mgrm.) and (true maternal mean − 50 mgrm.). There is thus, we venture to say, no strong probability that the numbers by which Professor Johannsen describes his grandparental beans represent the mean character of the seeds of the corresponding plants within ± 100 mgrm.

Again, the whole evidence, that the coefficient of filial regression within the line is zero, rests on the tables on pp. 21—24; but in these tables we are only told (1) the mean weight of seeds

* A preliminary study of homotyposis in the bean must of necessity precede any attempt to measure plant character by a single seed. Professor Johannsen would have to show that the homotypic correlation was perfect to justify his measure. This is very far from the fact not only in *Phaseolus vulgaris*, but in all beans hitherto examined from this standpoint.

produced by a mother-plant, representing the maternal character in a line; (2) the weights of individual seeds, taken from this mother-plant and sown; and (3) the mean weight of the seeds borne by each resultant plant. The regression coefficient, which Professor Johannsen regards (without any very adequate proof) as equal to 0, is between the deviation of the *individual beans* (2) and that of the mean character of the series of plants (3) resulting from them. We have therefore (1) the maternal generation defined by the mean character of all the beans borne by a plant; (2) a second generation, children of the maternal plant, each defined in the same way, by the mean character of the beans it bears; we have no third generation at all, and the regression which Professor Johannsen has observed seems to have little bearing on the question at issue, which could only be determined by growing a third generation from representative offspring of the filial plants, describing each plant of this generation as those of the two previous generations were described, in terms of the mean character of its seeds, and then determining the correlation between the characters so described in the two successive generations, the children and grandchildren of the single plant originally used to determine the line.

The question, which the tables given do to some extent answer, is the question what relation exists between the character of two seeds from the same mother-plant, and the character of the plants produced when those seeds are sown. Now it seems clear that if we take small beans out of a general harvest of seed, we shall be to some extent selecting the seeds of plants which bore on an average small beans; but what reason is there for supposing that the small and the large seeds from one and the same plant will lead to groups of plants bearing respectively small and large seeds? The hypothesis involved in this supposition seems somewhat analogous to the view that out of two eggs of a clutch, the smaller will produce a hen laying smaller eggs than that produced from the larger; this may well be quite fallacious, and it may yet be true that out of large masses of eggs, small eggs produce on the whole hens which lay small eggs. The absence of relationship of marked kind between the weight of seed sown, and mean weight of seed produced by the resulting plant, seems to have no bearing on the problem whether selection within the line can produce a change of character.

One further point we must notice; the *Uebersichtstabelle* 4 (pp. 36—37) has been treated in a quite illegitimate way, which would make the coefficients of correlation and regression = 0 between any two variables whatever.

If, as Professor Johannsen believes, the individual differences between members of any one generation were mere fluctuations, having no hereditary value, then a given generation ought as he says to be as well determined by selection of its grandparents as by selection of its parents. We cannot determine whether this is true of the average character of plants in Professor Johannsen's experiments, because the necessary data are wanting; but we can determine roughly the relation between three successive generations of *individual beans*. The material has been selected in such a way that the standard deviations of the successive generations have clearly quite artificial values, so that the correlations obtained are not very trustworthy; further, the exact weights of beans are not always given, so that we have been obliged to place a bean recorded as lying between say 400 and 450 mgrm. in the middle of its category. With these qualifications, we find

Correlation of Mother Bean and Offspring Bean $r_{01} = 0{\cdot}3481 \pm 0{\cdot}0080$,

Correlation of Grandmaternal Bean and Offspring Bean $r_{02} = 0{\cdot}2428 \pm 0{\cdot}0086$.

If we wish to predict the weight of a given bean of the filial generation from the known weight of its maternal bean, we must form a regression equation, which becomes

Probable weight of Offspring bean = $538{\cdot}31 + 0{\cdot}2691 \times$ weight of Maternal Bean .....(i).

If we wish to predict the weight of a filial bean from knowledge of the grandmaternal bean, we obtain the regression equation

Probable weight of Offspring bean = $417{\cdot}41 + 0{\cdot}1074 \times$ weight of Grandmaternal Bean...(ii).

This shows us at once that from Professor Johannsen's own data the maternal bean is more than twice as influential as the grandmaternal bean in settling the weight of the filial generation.

If we correlate the selected maternal and grandmaternal beans, we find the correlation, $r_{12}=0{\cdot}2532$; and from this and the preceding correlations we find the double regression formula

Probable weight of Offspring bean

$=\,?30{\cdot}71+0{\cdot}2373\times$ weight of Maternal Bean $+0{\cdot}0731\times$ weight of Grandmaternal Bean...(iii),

showing again the predominant influence of the maternal bean.

If we were to calculate the mean weights of each array of offspring means from (i), (ii) and (iii), we should expect the mean errors of the results to be in the ratio of

$$\sqrt{1-r_{01}^2},\ \sqrt{1-r_{02}^2} \text{ and } \sqrt{\frac{1-r_{01}^2-r_{02}^2-r_{12}^2+2r_{01}r_{02}r_{12}}{1-r_{12}^2}},$$

or in this case as

$$1{\cdot}014 : 1{\cdot}050 : 1.$$

We have applied (i) (ii) and (iii) to the 65 arrays of offspring given by Professor Johannsen, and the mean errors are

$$44{\cdot}3;\ 45{\cdot}5, \text{ and } 42{\cdot}8$$

or in the ratio of

$$1{\cdot}035 : 1{\cdot}060 : 1.$$

These numbers are, perhaps, as close as we could expect, and they show that we do in fact get better results from a knowledge of maternal bean than from knowledge of grandmaternal bean, and better results from a knowledge of both together than from a knowledge of either alone.

We hold therefore that Professor Johannsen's results prove:

(1) That there is a regression from parent to offspring, leading to the inference that parental correlation has for *Phaseolus vulgaris* a value closely identical with that found for other animals and plants, when we compare mean parental and mean filial characters;

(2) That when we compare the characters of individual seeds in successive generations the correlation between a seed and its parental seed is so much greater than that between a seed and its grandparental seed (both belonging to the same pure ancestral line) as to give strong evidence that characters arising in one generation within the line are inherited, and do therefore afford a basis on which selection may act.

W. F. R. W. AND K. P.

II. Addendum to "Graduation and Analysis of a Sickness Table" (*Biometrika*, Vol. II. p. 260). By W. PALIN ELDERTON.

On p. 261 it is stated that Gompertz' hypothesis may be viewed as the quotient of two normal curves, and it will be interesting to see how Makeham's useful modification of Gompertz' theory may be stated from the same point of view. Makeham's hypothesis is that the force of mortality may be represented as $A+Bc^x$, which, from our point of view, means that if we take a normal curve as the exposed we get $(A+Bc^x)\,y_0 e^{-x^2/2\sigma^2}$ for the deaths, and this can be thrown into the form of two normal curves of the same standard deviation, viz.,

$$\frac{N_1}{\sigma\sqrt{2\pi}}e^{-x^2/2\sigma^2}+\frac{N_2}{\sigma\sqrt{2\pi}}e^{-(x-h)^2/2\sigma^2}.$$

If we wish to apply Makeham's hypothesis to a table we can take a normal curve, multiply by q_x (the probability of dying in a year), and then fit the expression just given to the figures we obtain. The best way to do this will be by moments about the origin of the normal curve chosen for the exposed and, writing μ_1 and μ_2 for these, we have

$$h=\frac{\mu_2-\sigma^2}{\mu_1} \text{ and } N_2=\frac{(N_1+N_2)\mu_1}{h},$$

which is the complete solution. As Makeham's hypothesis only holds good for part of a mortality table we must choose our exposed curve so that the deaths resulting therefrom will be insignificant below say 25 in youth and above 85 in old age. Using $\sigma=8{\cdot}3$ and $50{\cdot}5$ as origin I made a trial with the H^M Mortality Table (*Institute of Actuaries, Healthy Male Lives*). I grouped the deaths corresponding to this assumed normal curve for every five years of age and using Sheppard's adjustment for the second moment, found $h=6{\cdot}4703$ years, and hence $\log_{10}c=\frac{h}{\sigma^2}\log_{10}e=\cdot040464$. The graduation in the Text Book for actuaries uses ·039657 and Professor Pearson gave ·0406405 in *Biometrika*, Vol. I. Part 3. We thus reach an extremely easy method of satisfactorily finding c.

Using the same normal curve and process with the graduated sickness rates I found $\log_{10}c=\cdot0465901$ and the resulting rates gave a good agreement from age 30 to age 80. An attempt to fit the whole sickness table was made by taking $\sigma=12{\cdot}5$ and $47{\cdot}5$ as origin and the value of $\log_{10}c$ was found to be ·040133 but the result was unsatisfactory as regards graduation.

The fact that Makeham's hypothesis fits Sutton's sickness table to the same extent as it does a mortality table is further evidence of the close relationship existing between the two classes of tables.

III. **Craniological Notes.**

(iv) *Homogeneity and Heterogeneity in Crania.*

By Charles S. Myers.

Professor Pearson's vigorous denunciation* of my criticism† of Miss Fawcett's memoir‡ on the Naqada skulls gives me a welcome opportunity of strengthening the position I took up.

(i) It may be remembered that, in order to determine whether or not the Naqada material belonged to a homogeneous race, Miss Fawcett compared the variability of skull-lengths (and of other measurements, which for brevity's sake I have here to neglect) in the Naqada series with the variabilities in four series, which were considered to be of an admittedly homogeneous character, viz., in a Bavarian, an Aino, a French and an English series. The variabilities of skull-lengths in these four series were found to be 6·088, 5·936, 7·202 and 6·446 respectively. Now, taking the skull-lengths of a mixed series of Australian, Guanche, Eskimo and Chinese skulls, I obtained a variability of 8·389; whereupon I concluded that if a small series, which was as heterogeneous as could be conceived, showed a skull-length variability of 8·389, such material as contained variabilities ranging between 5·722 (in the Naqada series) and 7·202 (in the French series) could not reasonably be termed homogeneous. That inference, I thought and still think,

* *Biometrika*, Vol. II., pp. 345—347. † *Man*, February, 1903, pp. 28—32.
‡ *Biometrika*, Vol. I., pp. 408—467.

was one which could be safely drawn, even by a mind so devoid of mathematical and statistical training as Professor Pearson imagines mine to be.

(ii) Professor Pearson has met my criticism by two different lines of argument. In the first place, he pretends to be able to determine the degree of probability that a series of five members will contain a sixth of a larger value; and he asserts that the odds are 42,552 to 1 against the appearance of the variability of my mixed skull series (=8·389) in a series composed of variabilities of the so-called homogeneous series. Surely common sense repudiates the legitimacy of such a calculation. But if mathematics allows it, what must also be the odds against the appearance of the figure 7·202 in the same series! Yet this figure actually occurs there, being the measure of variability of the 860 French skulls from the Paris catacombs.

(iii) Hereupon Professor Pearson changes front and casts a doubt upon the homogeneity of the French series; instead of the figure 7·202 he proceeds to introduce the figure 5·942, obtained from some 77 Parisian skulls which suit his purpose better. Moreover he substitutes the figure 6·085 for the figure 6·446 which Miss Fawcett had used without mention of the fact that it was the variability of a measurement which differed from the rest. With these modifications and with the addition of other suitable data Professor Pearson obtains still greater odds against the appearance of my figure 8·389 in a "homogeneous" series.

(iv) My criticism, however, is as valid now as it was when delivered. It was directed not against Professor Pearson's later revocations, but against Miss Fawcett's paper (for "the editing and arrangement" of which he definitely admits himself "responsible"), in which the variability 7·202 is unquestionably included in a table of variabilities of material, the whole of which is styled "admittedly homogeneous." Surely Professor Pearson must see that, by neglecting the inconvenient values 7·202 and 6·446, the former of which approaches so nearly the measure of variability of my heterogeneous series, he evades the question at issue. What I had in mind to ask was this—where, in the opinion of the biometric workers of University College, does homogeneity end and heterogeneity begin, if variabilities of 5·7, 6·4 and 7·2 appear in homogeneous series and a variability of 8·4 appears in a series which has as composite a character as can be imagined? My criticism, if it has served no further purpose, has at least elicited an answer to this question. In his defence of Miss Fawcett's memoir, Professor Pearson fixes the higher limit of homogeneity at or about 6·5. Consequently the French catacomb skulls ought never to have been included in a table purporting to contain only homogeneous material.

Passing from the mathematical to the biological side of the problem, I will admit the right of the mathematician to distinguish relative homogeneity and heterogeneity; but he must remember that the difference is purely a relative one. The Naqada material, if styled homogeneous today, would become heterogeneous tomorrow, should a series of still earlier and far more homogeneous crania come to hand. But the mathematician has no right to conclude, as in point of fact Miss Fawcett concludes, that therefore "we are justified...in speaking of a Naqada *race* and not merely of the Naqada crania." Professor Pearson may be able to define homogeneity to his satisfaction, but in our present ignorance none can define the exact meaning of racial purity. It may be that the variability of the ancient Egyptians is relatively small; but their population undoubtedly included well-nigh as many specimens of "races" as it does at the present day. I have examined "prehistoric" Egyptian skulls in sufficient number, to be convinced that the Naqada series contains skulls which have markedly negroid characters, between which and the more delicately chiselled features of Mediterranean and allied peoples there is every gradation, just as occurs among the *fellahin* of modern times. So also, to speak of a *race* of Englishmen disinterred from Whitechapel, or to speak of a *race* of French peasants, as Professor Pearson would have us do, is to ignore every lesson which physical anthropology, philology and history can teach us. The truth is that at present we have no evidence of an isolated race, which has never been contaminated by admixture with other races. We are ignorant, therefore, of the characters of such a race, of its variability, for instance, in head-, nose- or hair-form. And until appropriate material comes to hand, statistics and anatomy are alike powerless to help us.

Remarks on Dr C. S. Myers' Note.

Dr Myers seems to have entirely mistaken, not only the nature of Miss Fawcett's original memoir but of my defence of that memoir. A reply to him must have much of the nature of the traditional fight between the horse and the whale. I have not much hope of convincing him of the necessity for using exact methods in statistical enquiry, but I have hope that a new school of anthropologists will arise, who will be able to choose between the old and the new paths.

(i) Miss Fawcett started her work on the Naqada crania, without I am sure any prejudice, as to their heterogeneity or homogeneity. The test of the category into which they were to be placed was not as Dr Myers suggests a mere comparison of these skulls with "four series which were considered to be of an admittedly homogeneous character." On the contrary we were fully aware of the view taken by certain Egyptologists, that the Naqada crania differed widely from those of the historic Egyptians, and further that a whole series of races were supposed to have occupied Egypt in prehistoric times, and further that these races were represented in this series of crania. For this reason the crania were classified into groups according to the antiquity of the fragments found in the graves. This matter is dealt with in pp. 422–3 of the memoir. On the basis of this investigation no significant chronological differences could definitely be predicted of the Naqada crania. This was the first stage in Miss Fawcett's test. The second stage was to compare the variability of the Naqada crania for length and breadth with the known values for other series. Judged by both length and breadth they are less variable than the "Altbayerisch" crania; judged by length only than the Aino crania, both undoubtedly very homogeneous series. If the word "race" is to be used at all, it may certainly be used of the Ainos and Altbaiern, where for years close intermarriage must have gone on*. Here, I think, is possibly the source of some of my difference with Dr Myers. In my view any race may originally have arisen from a mixture of races, but such a mixed race is wholly different from a mixture of races, which have not interbred. It is with a mixture of races which have not interbred, Australians, Guanches, Eskimos and Chinese, that Dr Myers proposed to compare our material. I said and I repeat now that our Naqada series belongs to a totally different order of variability. Our English crania belong to one district and one period, our French catacomb crania to one district, but to a succession of periods, our Bavarian and Aino to very limited districts with probably close inbreeding. The Naqada is as little variable as the least variable of these series. There appears accordingly no legitimate foundation for treating it as a series of crania composed of individuals from such different races as the Egyptologists have suggested. Dr Myers without having examined the Naqada crania, says that he has examined sufficient "prehistoric" Egyptian skulls† to be convinced that the Naqada series contains skulls which have markedly negroid characters "between which and the more delicately chiselled features of the Mediterranean and allied peoples there is every gradation." There may be Naqada skulls with negroid characters; it is easy to assert such to exist, and there is no finality to mere matters of opinion, which cannot be put to a quantitative test. But the series has been examined by anatomical craniologists of equal judgment with Dr Myers. Professor Sergi, who has seen the crania, classed them definitely as belonging to his "Mediterranean race." Dr Myers who has not seen the crania finds that they contain skulls of negroid character which differ from those of the Mediterranean peoples. On the whole I think the biometrician can afford to smile at the judgments of the non-biometrical craniologists who presumedly alone pay attention to the "lessons which physical anthropology, philology and history teach us"!

(ii) Dr Myers asserts that I met his criticism by *two* lines of argument. I don't think so at all. I merely showed him how he ought scientifically to have determined whether his

* There is strong feeling throughout the Tirol and surrounding districts against marriage with a stranger,—often leading to the mobbing of a bridegroom from another locality.

† I shall on another occasion have a good deal to say about the conclusions Dr Myers has published on Egyptian skulls, and on the methods he has used in drawing those conclusions.

mixture of crania belonged or not to the same category as the series dealt with on p. 424 of Miss Fawcett's paper. Having shown that the absurdity of comparing it with these series was measured by odds of 42,552 to 1, I said that the whole problem deserved consideration from a wider standpoint. In other words I took up *de novo* the question of biometrically determining the degree of homogeneity in cranial series on the basis of length and breadth measurements, and obtained results which I hoped might be helpful in future. I did this because mere controversy is very distasteful to me, even when it is striving to pull a great branch of science out of the discreditable rut it has been brought into by the use of hopelessly unscientific statistical methods. I fail to find any change of front in this, for the catacomb data had already been dealt with as suspect on account of the remarkable proportion of the two sexes. Dr Myers' mixed series was dismissed on the odds of 42,552 to 1; it is hopelessly more heterogeneous than the worst of the four series quoted by Miss Fawcett. I then proceeded to get a *more refined* test, by replacing the French data,—which I hold not to be a race mixture, but a mixture of individuals (and possibly sexes) from the same race at different periods,—by a series of Parisian crania from one period, provided for me by the doyen of French craniologists as a homogeneous series. There is no change of front, merely an endeavour to reach a still better criterion*.

(iii) Lastly, I turn to the saddest part of Dr Myers' letter, for it shows how little hope there is that he can ever be converted to the more modern view of statistics as an exact science. Instead of in the least replying to my chief contention *that no number is absolutely great or small*, he writes as follows about my calculation of the odds against his mixture of 42,552 to 1:

"Surely common sense repudiates the legitimacy of such a calculation. But if mathematics allows it, what must also be the odds against the appearance of the figure 7·202 in the same series! Yet this figure actually occurs there, being the measure of variability of the 860 French skulls from the Paris catacombs."

All mathematics are merely common sense in symbols and the divergence between the two can only arise from a slip in the mathematics, or because a writer labels as "common sense" what is not sense but what he wants to believe. Let me suggest to Dr Myers the following experiment: Let him take 12 pennies and toss them 100,000 times. He will find that only about 24 times in 100,000 trials, or once in 4167 trials, he will obtain all twelve heads. He would obtain nine heads in about 5371 cases out of his 100,000 trials, or about once in 18 trials. This is mathematical, but I know from experience that it is very closely indeed "common sense." Now would Dr Myers be justified in saying that $12-9=3$ is very small and arguing as follows?

"Surely common sense repudiates the legitimacy of a calculation giving 4166 to 1 against 12 heads. But if mathematics allows it what must also be the odds against the appearance of the figure 9 in the same series of penny tossings! Yet this figure actually occurs in penny tossings."

I hope Dr Myers will not think me flippant, but the arguments are really quite parallel, except that his 8·389 is *more than ten times as improbable as the twelve heads occurring*. The standard deviation in this case of penny tossings is 1·732 and the mean number of heads of course, six. Thus, nine heads differ by not quite twice, and 12 heads by not quite four times, the standard deviation from the mean. Now in the case of the crania the mean was 6·279, the standard deviation ·5185, and the French skulls' variability 7·202, or it differs 1·780 times the standard deviation from the mean. A deviation greater than this will occur once in 25 trials,

* Dr Myers' mixture is absurd in comparison with the French catacomb crania. Why is it a change of front to show it is infinitely more absurd when we use still more homogeneous material? His proper reply would be to show that as we improve our material the Naqada series becomes very improbable, but this is not the case.

as the odds are 24 to 1 against it. In other words, in every eight tables like Miss Fawcett's of like material, we should expect to find a skull-series of length variability equal to the French *once*. There is therefore nothing whatever improbable about it on the data of Miss Fawcett's table. But Dr Myers' mixture has a variability which differs 4·07 times standard deviation from the mean, and this will occur between 2 and 3 times only in 100,000 trials. In other words in 10,000 tables like Miss Fawcett's, we might expect to find one case like Dr Myers' mixture! Shortly the odds in the two cases are not comparable. I am sorry if this is unintelligible to Dr Myers, but he asks in astonishment what must be the odds against the French series with a variability of 7·202, thus again only emphasising his failure to appreciate what are 'large' and what are 'small' differences. Such differences can only be appreciated by a study of the elements of the theory of probability, and I would venture to suggest a little experimental coin-tossing and possibly a study of Westergaard to all craniologists who imagine that nothing but the elements of arithmetic are necessary in statistical investigations.

K. P.

(v) *Note on Cranial Types.*

By Professor Dr Aurel von Török.

Da im Part III. Vol. II. 1903, S. 339 der *Biometrika* ("I. Prof. Aurel v. Török's attack on the Arithmetical Mean") behauptet wird, dass ich den Begriff eines Typus so auffasse: als würde mittels desselben das Individuelle von irgend einer Bevölkerung von dem Individuellen einer anderen Bevölkerung differenziert ("which differentiates an *individual* of one population from an *individual* of a second population")—welche Behauptung aus den Erörterungen (meiner und meines Mitarbeiters Abhandlung "Über das gegenseitige Verhalten etc.") mit Berechtigung nicht aufgestellt werden kann, weil hiergegen auch schon der Grundbegriff des von mir definierten Typus spricht die auch Herr Prof. Karl Pearson zitiert: "So kann...die Bestimmung eines Typus in gar nichts anderem bestehen, als dass man unter dem Mehrerlei der Einzelmerkmale dasjenige herausgreift, was in der grossen Überzahl an zu treffen ist" (aus der Überzahl der Einzelfälle kann doch niemals das Individuelle abgeleitet werden, weil umgekehrt aus den einzelnen Individuellen die Allgemeinheit bez. Überzahl abgeleitet wird); so bitte ich um die Aufnahme folgender Berichtigung.

Mein Angriff (attack) gegen die arithmetische Mittelzahl beschränkt sich einzig allein auf den bisher nur zu oft benützten Unfug: um schon mittels alleiniger Mitteilung der arithm. Mittelzahlen den Typus für eine Menschengruppe (Rasse) auf zu stellen. Wenn also Herr Prof. Karl Pearson in der Kritik gegen mich aussagt: "A knowledge of the arithmetic means only would never enable one to say of an individual skull that it belonged to one race and not to another"; so kann gerade ich hierin eine Bestätigung meiner Ansicht, über den bisherigen allgemeinen Gebrauch der arithm. Mittelzahlen mit Genugtuung auffinden.

Ferner bitte ich um die Erlaubnis noch folgender Bemerkungen.

Ich halte den Begriff "Rasse" und "Typus" streng auseinander. Der Begriff "Rasse" ist ein aus der Zoologie übernommener und ist mit der Abstammungsfrage unzertrennlich verbunden; hingegen habe ich seit je her unter dem Begriffe "Typus" nur die in Überzahl der Einzelfälle innerhalb jedweder Menschengruppe (Familie, Geschlecht, Sippe, Stamm, Volk, Rasse) vorkommenden Merkmale verstanden. Es verhält sich der von mir interpretierte Typus zur Rasse, wie ein Unterbegriff zum Oberbegriff. (Der Begriff Rasse vereinigt in sich mehrere Typen.)

Nur der Typus oder die Typen innerhalb irgend einer Rasse können mittels der mathematischen Methode bestimmt werden; hingegen die Frage ob die betreffende Menschengruppe

(Rasse) "blutrein" oder "blutvermischt" ist d. h. der Nachweis, dass die betreffende Menschengruppe niemals einer irgendwelchen Blutmischung unterworfen war—kann wenigstens nach meiner Überzeugung niemals mittels der bisher bekannt gemachten mathematischen Methoden nachgewiesen werden. Wäre dies möglich, so könnte auch die ganze Abstammungsfrage der Menschheit (die sog. Rassenlehre) auf rein mathematischem Wege endgültig geschlichtet werden. —Ich muss wenigstens für die bisher angewendeten mathematischen Methoden—und so auch für die von Herrn Prof. Karl Pearson eingeführte Methode dies aufrecht halten.

Es wäre doch im Interesse der "Biometrika" wenn Herr Prof. Karl Pearson sich die Mühe nehmen würde, um die für uns so höchst wichtige Rassenfrage (d. h. die Abstammung und Begrenzung der einzelnen Rassen) auf rein mathematischem Wege behandeln und zum endgültigen Abschluss führen würde.

Endlich hätte ich die Bitte, wenn Herr Prof. Karl Pearson sich die Mühe nehmen würde, mein neues Verfahren: die Einzelmaasse nach den drei Vergleichungsgruppen (kleine, mittelgrosse, grosse Maasswerte) zu bestimmen, um den korrelativen Typus aufstellen zu können —einer strengen ausführlichen Kritik unter zu ziehen: da der wesentliche Teil der von ihm kritisirten Arbeit eben sich auf dieses Moment bezieht.

Prof. Dr Aurel von Török,
Anthropologiai Múzeum, Budapest, 1903. vii. 10.

Remarks on Professor Aurel von Török's Note.

I feel precisely the same difficulty about controversy with Professor von Török as with Dr Myers. We do not think in the same plane. Professor von Török has criticised the arithmetic mean because: (i) it does not give what occurs in the great majority of individuals, (ii) it does not give the modal value, (iii) it does not give the median value of a character. My defence of the arithmetic mean was that nobody expected it to fulfil (i), but that within the limits of random sampling it did in the material actually used in Professor von Török's memoir satisfy (ii) and (iii), although that material was cited to prove the exact *opposite*. To all this Professor von Török makes no reply whatever.

I am sorry if I have misunderstood Professor von Török in supposing him to consider that the type differentiates an *individual* of one population from an *individual* of a second population. What he actually wrote was:

> Wenn unter dem Wortausdrucke "Typus" dasjenige verstanden werden muss, was für die Gesammtheit irgendwelcher Dinge charakteristisch ist, wodurch man also dieselben von anderen sofort präcis zu unterscheiden im Stande ist: so kann—wie dies schon in dem voraufgehenden Capitel berührt wurde—die Bestimmung eines Typus in gar nichts anderem bestehen, als dass man unter dem Mehrerlei der Einzelmerkmale dasjenige herausgreift, was in der grossen Ueberzahl anzutreffen ist*.

I can only consider that an over-emphasised sense of grammatic purity led me to hold that *dieselben* referred to the *Dinge* in the *Gesammtheit* and not to the *Gesammtheit* itself and *anderen* to *Dinge* in other *Gesammtheiten* and not to other *Gesammtheiten* themselves. But if the *type* be as I suppose, and as I am glad to find Professor von Török agrees it should be, something characteristic of the population or *Gesammtheit*,—why is it at all needful that it be present in "the great majority" of the individuals of the population? If the type be not that which distinguishes an individual of one race from an individual of another, but only a feature of the population as a *whole*, why should Professor von Török attack the arithmetic mean, because it is not a characteristic of the majority of a population? The standard deviations and the correlations of characters have absolutely no meaning relative to any individual of a population,

* *Zeitschrift für Morphologie und Anthropologie*, Bd. iv. p. 511.

but only to the population as a whole. Yet they help to fix its type in precisely the same way as the arithmetic mean does. Why should we demand of the latter, any more than of the two former statistical "population-constants" that they should be characteristic of the great majority of a population? It appears to me that there is still lingering in Professor von Török's mind something of the old confused notion of type, when he demands that any statistical constant which helps to describe the type shall be characteristic of the great majority of a population.

For the biometrician the type of any group (or "population" in the biometric sense) is fixed by the whole complex of statistical constants—means, standard deviations, correlations, skewnesses, etc., which suffice to differentiate it sensibly from other groups or populations. Very frequently the arithmetic means of a number of characters will suffice, if so they fix the type. Often we have to use a number of other constants—correlations or what not—and the question of whether two groups are different in type becomes an extremely delicate one, only solved by a careful consideration of the probabilities connoted by the probable errors of differences.

I am aware that the conception of 'type' thus given is not that of many anthropologists, but biometry is essentially a science of exact quantitative definition, and if it is to be of service in rendering anthropology an exact branch of science, it must replace vague ideas by numerically definite conceptions. If any anthropologist replies that: "'Type' is something to be judged by general appreciation," then I personally have no reply to make. He speaks like the anatomical craniologist in the language of an esoteric science and I do not pretend to criticise his conclusions. All I demand is that he should not use, what are to the mathematician hopelessly inadequate and faulty statistical methods to justify his "type" appreciations. If on the other hand he says: "There is a definite quantitative character I understand by type, which is not involved in your definition above," then biometricians are perfectly prepared to try and understand what it is, and will endeavour to give it a significant biometric definition and quantitative measure. When Professor von Török tells me that the type is something which is characteristic of the great majority of a population, group or *Gesammtheit*, I am at a loss, for although I have examined the characters of many groups, I have never found this something, to which I could attach the name type, except where the smallness of the variability rendered it possible on mere inspection to differentiate one population from a second,—as a black man from a white, a dark-haired from a light-haired people and so forth. Here, however, the unreasoned differentiation really depends on the biometric conceptions of different means and small variabilities. But because these conceptions are not the conscious source of the classification, the anthropologist appears to hold that the biometrician applies a wholly different process when he uses means and variabilities to distinguish the types of groups which in part overlap, as far as mere individuals are concerned. I am inclined to think that it is these cases of widely divergent means with small variabilities where differentiation is a matter of inspection only, that really lead to the confused notion of many anthropologists that the "type" is something characteristic of the great majority of a group.

Almost equally vague with the conception of type is the current conception of *race* in man. I am wholly in accordance with Professor von Török when he says that the problem of race is inseparably united with the question of descent, but if he thinks that biometric methods cannot apply to this problem I must venture to differ, and refer him for the sort of lines on which I think the problem will one day be solved to my memoir on the *Influence of Natural Selection on Variation and Correlation**. Turning to the special problem as concerns man, I hold that the whole evolutionary evidence is in favour of descent from very few groups, perhaps a single group. Hence Professor von Török's statement that it is impossible to settle by mathematical methods the problem of whether a given "Menschengruppe (Rasse) 'blutrein' oder 'blutvermischt' ist," understanding by "blutrein" that "die betreffende Menschengruppe niemals einer irgendwelchen Blutmischung unterworfen war" has no meaning at all for me, because his definition of "blutrein"

* *Phil. Trans.* Vol. 200, pp. 1–66. See especially p. 22.

seems to involve an eternal past for humanity or a separate creation of each so-called race. In other words his phrase: "*niemals* einer irgendwelchen Blutmischung unterworfen" seems to me to exclude entirely the evolution of humanity from a single original group or at least very few groups. It is not a practical definition of race at all, for under it we must say that race in man does not exist. Again granted differentiation into subgroups from an original stock, and that these subgroups have been acted upon by selection throughout long ages, again I hold that a definition of race as a subgroup which has remained without *Blutmischung* since that original differentiation is hopelessly idle. In all probability such a race does not exist in man. Probably every group of men is in this sense *blutvermischt*. If my view be a correct one, race in man is merely a *relative* term. I understand by a race of men, what I understand by a race of snails or birds or fox-terriers, i.e. a group which has intermixed freely with itself but not with other groups for a number of generations, and during this process has been equally freely subjected to the action of natural or artificial selection. Sensible isolation is generally needed for the first condition, probably fixity of locality for the second condition. The "perfect race" would be that which had for many generations been isolated in one locality and had freely "intrabred." As a result we should have a distinct "type," more or less stable to its environment. Of course in man we only get more or less close approximations to these conditions, and from such approximations we have every shade of imperfect mixture down to the mixed population of a European settlement in Asia, with but small *Blutmischung* among its different castes or subgroups. This pure relativity of race which is all I can conceive of in man as a practical definition, diverges probably very widely from the conception of Professor von Török, but it enables us at once to set up a standard,—a relative one it is true, but none the less perfectly sound for biometric purposes—of what may or may not be considered as homogeneous material. To apply our definition we must start from human groups which we know have been for a number of generations in the bulk isolated and freely interbreeding. These will give us a standard by which to judge of the comparative value of other groups. In this sense I think we are justified in speaking of the Ainos or the Altbaiern as races; we may speak of the French of a given rural locality as a race for there is comparatively little immigration, and so forth. But if we mix data for the same group at different periods, we shall not get a race because progressive changes are taking place. Above all we must never forget that our whole conception is one of *relative* degree. I shall no doubt be told that this conception of race is quite invalid, that races can be sorted out by types, long after blood-mixture, by the expert anthropologist. This may be so, but it throws us back on "appreciation" and the undefined, if not undefinable "type," a field quite outside biometric investigations. The instances of Eurasians, Indo-Spaniards, and half-castes in general, seem to me to show a continuous blending in man as the *Blutmischung* is continued. Stop the immigration into North America and let its multiracial elements interbreed for a number of generations, and be environmentally selected, and the complete blend of any locality will be as much a "race" as any district of Europe can now show 1000 years after the *Völkerwanderung*. With the extreme mobility of man and his ready fertility with any group of his own species, I do not believe that a more practical conception of race in man can be formed. The "purest" race is for me the one which has been isolated, intrabred, and selected for the longest period. It may well in the dim past have been a blend of the most diverse elements. Starting from this conception of race biometric investigations can enable us to form some rough measure even at present, of the position of groups on a racial scale. At any rate they enable us to assert that Ainos, Naqadas and Altbaiern, are indefinitely far removed on such a scale from mere cranial mixtures*. I do not suppose this conception of race will satisfy Professor von Török, any more than Dr Myers or other craniologists or anthropologists of the old school. But I would ask them to express concisely and definitely what they

* It would be quite possible to make out of Australian, Guanch, Chinese and European crania by an adroit selection a mixture which for one character was as little variable as that character in a "race" like the Aino, but I believe the biometrician would detect the mixture by simple analysis of other little correlated characters.

understand by "type" and by "race," and then we shall be able to see whether a quantitative definition can be found for the ideas which appeal to them. To the biometrician their ideas appear to be confused notions, for they turn either on "appreciation," which is out of his plane altogether, or on statistical methods which in nine cases out of ten are unsound.

In conclusion I would only reply to Professor von Török's request that I will submit to *einer strengen ausführlichen Kritik* his method of dealing with correlation, that I have already stated my opinion of his method*. It may be summed up as follows: In the present state of statistical science it is an extremely cumbersome method of dealing with multiple correlation. Four correlation coefficients and a multiple regression equation (such as those given in *Biometrika*, Vol. II., p. 349) should replace some 70 pages of Professor von Török's memoir. This replacement would not only give increased brevity, but increased accuracy, as all such cranial data demand graduation. Further in the present state of our craniological knowledge, it is fallacious to extend any result of intraracial correlation from one race to a second†, hence I do not think any conclusion from Hungarian data to the Neanderthal skull or the Anthropopithecus Dubois, can amount to aught but the vaguest suggestion.

The great value of Professor von Török's paper lies in the fact that a craniologist *von Fache* emphasises the importance of dealing with correlation, when cranial results are considered. This is an immense gain, and will have its influence on future continental craniological publications. At the same time the mathematical theory of correlation is quite simple, and one can only hope that in future continental writers will adopt the practice of publishing coefficients of correlation (such as have been used in biometric cranial memoirs since 1895) to indicate at a glance the relative degree of association between characters. The "multiple regression equations" and "partial correlation coefficients" then give concisely that relationship between the arrays, which Professor von Török is rightly but most laboriously seeking to express.

K. P.

* *Biometrika*, Vol. II. p. 353, footnote.
† *Biometrika*, Vol. II. p. 353, text.

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